JPRS 75827

4 June 1980

USSR Report

ENERGY

No. 16

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ELECTRIC POWER

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PLANNED CAPACITY FOR FIRST PHASE OF CHERNOBYLSKAYA AES

Moscow ELEKTRICHESKIYE STANTSII in Russian No 2, Feb 80 pp 7-11

[Article by V. P. Akinfiyev, A. D. Gellerman and V. K. Bronnikov, engineers, Chernobylskaya AES]

[Text] Nuclear electric power plants with RBMK-1000 reactors (large capacity channel-type reactor) are the base stations of domestic nuclear energy. The Chernobylskaya AES is the first industrial nuclear power plant in the Ukraine. In the first phase, two RBMK 1000 MW capacity reactors have been installed.

At the current time, construction has been completed and planned capacity of the first phase of the Chernobylskaya AES has been assimilated (Fig. 1). On 26 Sep 77, after six years of construction, the first power plant of the Chernobliskaya AES was connected to the grid. In parallel with assimilation of planned capacity of the first plant, construction, assembly and start-up and adjustment work was being done in a second plant. On 21 Dec 78 the second power plant was started up. Thus in seven years the first phase of the Chernobylskaya AES has been fully completed. Construction, assembly, adjustment and energy start-up of both plants of the first phase of the Chernobylskaya AES were done on the basis of a great deal of experience gained in the conduct of similar work at plants of the Leningrad AES imeni V. I. Lenin and the Kursk AES.

The Chernobylskaaya plant is a single loop model. Steam generated by the reactors and brought to the state of saturation in drum separators is fed to the turbine vanes. Each circuit requires very high quality assembly and adjustment work and imposes just as high requirements on purify of equipment and conduits.

The plant consists of an RBMK-1000 reactors, two K-500-65/3000 POT tubines of the Kharkov Turbine Plant employing saturated steam, and two TVV-500 generators of the LMZ. Uranium dioxide UO$_2$ enriched with 1.8-2.0 percent ^{235}U is utilized as the nuclear fuel. For continuous reloading of fuel while underway (without shutdown), a special unloading and loading machine is envisaged (Fig. 2). All primary and almost all auxiliary equipment is of domestic manufacture.

Figure 3 depicts the theoretical block diagram of the Chernobylskaya AES power plant. It is worth noting that the process water supply system, intermediate

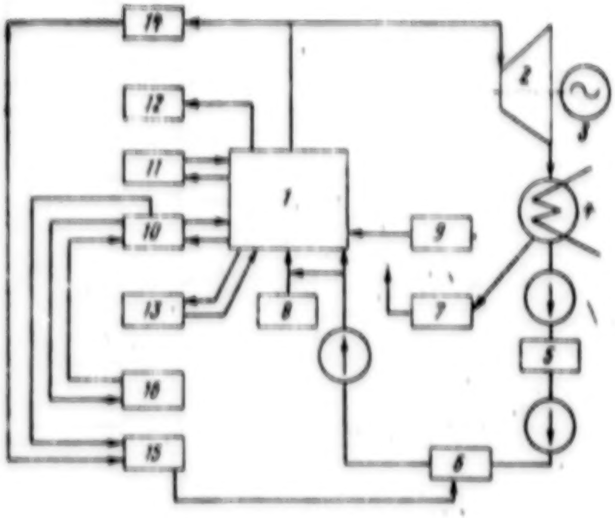

Figure 3. Block diagram of power plant with RBMK-1000 reactors.
Key:
1. multiple forced circulation loop with RBMK-1000 reactor
2. K-500-65/3000 turbine (2 ea.)
3. TVV-500 generator (2 ea.)
4. condensation installation.
5. condensate scrubber.
6. turbine regenerator, including deaerator.
7. explosive mixture igniter.
8. emergency cooling system.
9. sealing power system of main circulation pumps and emergency hydraulic system;
10. reactor venting and shut-down cooling system, including by-pass scrubber.
11. reactor control and protection control channel cooling system.
12. emergency vapor condensation system
13. gas loop of reactor with helium purifier.
14. emergency steam receiver.
15. tank management system of plant, including purification installation of organized and unplanned dumps.
16. intermediate reactor loop.

reactor facility loops, tank management system, including installation of organized and unplanned dumps, are common to the two plants (A more detailed description of AES operation with the RBMK-1000 is contained in "Eletrkcheskiye stantsii" No 1:10-15, 1979).

Successful assimilation of planned capacities of both plants of the Chernobylskaya AES was preceded by much start-up and adjustment work.

Start-up and adjustment work on both plants was done upon completion of construction and assembly work at individual facilities and systems. At plant

Number 1, it was begun back in March, 1977, i,e., six months before start-up. Start-up and adjustment on equipment was done by the operating staff of the plant with participation of the staff of other organizations: the Yuzhteploenergomontazh trust for wash out of conduits and testing of reactor and turbine systems; Beloyarsk AES adjustment organization for mode adjustment and reactor systems tests; Yuzhtekhenergo for mode adjustment and turbine shop system tests; Gidroelektromontazh trust for adjustment of electrical sytems; KIPiA and some other special organizations for start-up and adjustment of axuiliary equipment.

Completion periods of start-up and adjustment work on equipment of the reactor shop formed the critical path. It involved start-up and adjustment of turbine equipment and all other auxiliary systems.

Thus after the successful start-up of BNS-3--a water-level maintanence plant, BNS-2—a pumping station for technical water supply, transfer of chemical purification to a continuous raw water source and storage of chemically purified water (KhOV) in tanks for washing out the reactor shop system, the latter was successfully executed.

Prior to adjustment of equipment, high-speed washing was carried out on the conduits and equipment of the repeat forced circulation loop (KMPTs), the emergency reactor cooling system, venting and shut-down cooling system, "blow out" of the pipes of the lower water communications between reactor and technical channels (TK) with efflux of water to the central hall, pipes of steam communications to the drum separators (BS).

The circuits and venting modes were selected on the basis of kinetic energy of the flow in the pipelines of the system at a rate 1.5 times higher than nominal. But some of the pipelines were not speed-washed—they were mainly pipelines of large diameter, collectors, separators, tanks of the primary circulating pumps. They were cleaned manually and were kept clean.

The proplerly timed execution of analysis of plans for the power plants of the Chernobylskaya AES reduced periods of washing and blow out of primary technological equipment. Reconstruction of tank management resolved the problem of storing chemically desalinated water for start-up and adjustment work on other plants.

Because of the shock version of assembly of baffles which connected the tanks of the operating reverse of water reserve (soc-alled PPR tanks), tanks of chemically desalinated water reserve (BChK tanks) and one of the storage containers of liquid effluent (KhZhO), a KhOV reserve was prepared for washing out in sufficient quantities. Thus for the first plant this reserve came to 11,000 cubic meters; for the second it was 8,000 cubic meters. The blow out of the TK not by BChK (NDK) pumps, used for the first time in practice of similar work, but by hydraulics seal pumps of the main circulating pumps (NGU GTsN) reduced blow out periods, saved KhOV, achieved better cleaning quality of the internal surfaces of TK and NVK.

After carrying out cold washes, the hot wash of KMPTs was done to increase the quality of loop (circulating thorugh the reactor) water to legal levels. In the first period, due to poor analysis, some of the loop water was discharged into industrial catchment channels; then with the aid of the by-pass cleaning of water of the KMPTs then in operation (SVO-1), it was brought to the required levels.

Water temperature in hot wash out was 155-166°C. To remove mechanical contaminants from the KMPTs after cold washes, conical screens with a 1.8 x 1.8 millimeter mesh were installed in the group collectors.

The hot wash was done in steps:

filling of the KMPTS;
heating it to 150-160°C using the main circulating pumps and adjustment of automation operation and KIP;
performance of washing procedures;
shut-down cooling of the KMPTS and replacement of the screens in the group collectors.

At the Chernobylskaya AES (ChAES), a new plan was used to fill the KMPTs with the aid of the GTsN hydraulic seals, thus eliminating entry of mechanical compositions into the GTsN hydraulic seal system. Also for the first time, the emergency start-up system of the GTsN was used to control the rate of heating and cooling of the KMPTs during the start-up and adjustment work; this ensured feed of up to 60 tons/hr of cold water into the loop.

These methods of washing permitted KMPTs water quality to be brought to standards corresponding to the "Temporary Technological Regulation" (Zh-8 meq/kg, Fe = 100-200 mcg/kg) in three to four days. The use of the new progressive technology at many stages of start-up and adjustment work greatly accelerated the entire process of start-up and adjustment and reduced overall periods of preparation of the first plant for start-up.

Physical Start-up. The next stage in prestart-up work is loading nuclear fuel into the reactor and physical start-up.

Full-scale loading of the reactors of the first plant with fuel, physical start-up and physical experiments were done on the basis of experience gained in starting-up plants at LAES and KAES. Analysis of this experience revealed the reality of reducing loading periods with the timely start of work on preparation of nuclear fuel and additional neutron absorbers (DP). By the start of loading, 240 DP and over 500 heat-liberating assemblies (TVS) with suspensions were accumulated.

Because of the above high reserve of TVS during loading into the reactor using a TsZ bridge crane, the simultaneous installation of two TVS at two speeds was used.

The first use of this technology in the loading of RBMK-1000 reactors, and the arrangement of competition between shifts with wide publication of the results made it possible to carry out full-scale loading of nuclear fuel in the reactor of the first plant of ChAE in record time—in a total of 14 days. This was a valuable contribution to the practice of loading a reactor of this capacity.

Experiments run during physical start-ups of both reactors showed excellent conformity of physical parameters of the reactors to planned values. In the first plant of ChAES, the possibility of shaping reactor load by extracting additional neutron absorbers (DP) without replacing them with TVS was tested and established for the first time: this reduces the radial coefficient of non-uniformity of energy liberation and increases the actual reserve of reactivity in the initial stage of operation.

Energy start-up. After finishing work on preparation and adjustment of equipment of the first plant for start-up, successfully conducted blow-out of live steam conduits with steam from the reactor at a pressure of up to 22 kgs/cm^2, the first plant of ChAES on 26 Sep 77 was ready for comprehensive sampling by connection to the Kievenergo grid.

In the period of comprehensive sampling and the first months of operation of this plant it was found that the circulating water supply system did not provide the planned flow rate of water through the turbine condensors. With fully opened overflow valves there was a partial separation of the siphon in the upper water chambers of the condensors, leading to vacuum losses in some instances. Tests also showed that in the event of stoppage of circulating pumps only half the water reserve in the pressurized tank could be used. Careful analysis suggested that the cause for these phenomena was the accumulation of gases in the upper regions of the overflow circulating conduits.

To eliminate cases of siphon separation, a device was constructed to ensure additional suction of air from the horizontal sections of the drain circulating conduits after the valves. Incorporation of this measure eliminated the possible accumulation of gases in the drain circulation conduits, removed the hazard of siphon separation; this enabled operation with fully open drain valves and the planned flow rate of circulating water through the turbine condensors. At the same time the reliability of operation of the turbine oil coolers was enhanced, since the drain conduits of the coolant after the oil coolers led into overflow circulation conduit, in a zone of possible accumulation of gases, which led to siphon separation of oil coolers and cut off of flow of coolant through them.

With assimilation of nominal and similar loads of the turbine generators, cases of corrosion of the regulating members of steam feed to the turbines became common. Structural measures elaborated and incorporated jointly with POT KhTZ reduced to a minimum the cases of corrosion at the levels of capacity close to nominal and brought the turbine control system into conformity with PTE requirements.

Shortcomings in construction and manufacture of separator steam reheaters (SPP) led to repeated disconnections and, as a result, to a reduction in turbine capacity. In collaboration with ZiO, a method was elaborated and realiazed for strengthening the welded junction of pipes to modules, and mode adjustment determined the most favorable conditions of SPP operation, sharply enhancing their reliability.

The fulminating mixture ignition installation, with whose connection the primary ejectors operated less stably, and the unsuccessful drain system of the primary ejectors reduced the overall reliability and stability of the power plant. This was eliminated by redesigning the primary ejectors and their drainage system.

With assimilation of capacity close to planned, it was found that the design of intrahousing devices of drum seaparators would not permit generation of steam with the rated degree of dryness. Steam moisture content reached 1.5 to 2 percent at the output from the BS. This reduced economy and reliability of operation of the turbines because of premature corrosive wear of the vane apparatus. Inspection of the BS showed that the entrainment of moisture resulted from the large hydraulic seal at the overflow of the separator from the lower tube sheet. Redesign of the edges of the lower tube sheet of the BS reduced steam moisture content to planned standards (= 0.05 percent).

Experience of assimilation of capacity showed that the plan envisaged a comparatively large amount of small equipment, raising the cost and complicating assembly, operation and repair.

The VEM-6 2000/40-125 breakers, rated in plant s.n. connections of the Rovno Plant of High Voltage Equipment required redesign to enhance their cut-off ability.

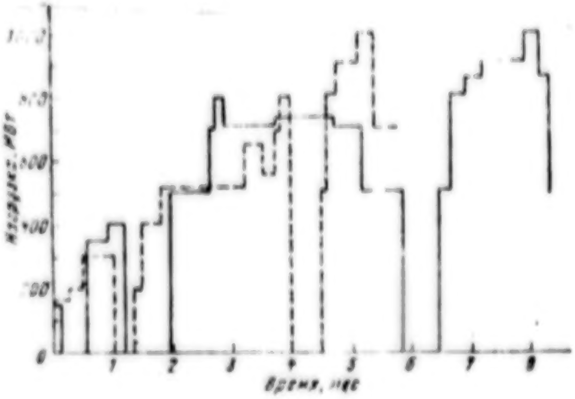

Figure 4. Rates of assimilation of planned capacities of the first (solid line) and second (dotted line) plants of the Chernobylskaya AES.

Despite these problems, energy start-up of the first plant of the Chernobylskaya AES was completed with the successful emergence at planned capacity of 1,000,000 kW on 24 May 78. Therefore, planned capacity was assimilated in only eight months. This was made possible because of the conscientious creative labor of all plant personnel, wisely and effectively organized socialist competition at the enterprise among shops, sections and shifts, clearly and correctly formulated efficiency expert analysis. Thus in 1978 alone, 244 efficiency expert proposals aimed at enhancing efficiency and reliability of operation of the

Chernobylskaya AES were incorporated.

Year/month	Generation of electrical energy, million kWhr	Consumption of electrical per s.n., %	Coefficient of utilization of rated capacity	Average load MW	Coefficient of readiness of equipment to carry load, %
1977 Oct	86.9	24.8	11.7	336	11.6
1978 Jan	534.2	8.44	71.8	718	80.0
1978 May	621.1	7.64	83.5	854	89.7

Enhancement of reliability and handling of the Chernobylskaya AES. Long operation of the power plant at nominal capacity of 1,000,000 kW, however, was hindered by several factors.

To enhance stability of plant operation, the following primary decisions were made:

the quality of level control under transient conditions in BS was enhanced as a result of elaboration and incorporation of a new scheme of primary level regulators in BS using GSP "Kaskad" equipment which operates with unified signals of 0-5 mA. The probability of disconnection of the plant for intolerable deviations of levels in BS was greatly reduced;

an automatic reserving scheme was incorporated for the primary power regulators of the BS and pressure into the BS which permits, upon appearance of any signal of emergency shutdown, the connection of backup regulators, which to a great extent favors the maintenance of the regulated parameter;

a rapid relief of capacity was elaborated and incorporated based on a capacity limiter with cycling of AZ-5 protection and a pressure drop in BS, permitting adjustment turbine load in conformity with the diminishing reactor capacity;

protection against an emergency drop in flow of feed water was realized for the first time in such reactors using standard equipment of the system of physical monitoring of energy liberation distribution.

The protection underwent a series of tests and has long been in successful operation.

During the assimilation of the AES, conditions were worked out for smooth control of helium concentration in the gas mixture with blow out of the graphite pile; this not only reduced losses of expensive helium, but also optimized the nuclear-physical conditions of the reactor.

After realization of several meausres aimed at enhancing reliability and stability of operation of plant number 1, the ChAES, as a rule, has carried nominal load of 1,000,000 kW in each power plant.

The growing experience of operating staff permitted assimilation of nominal capacity of the second power plant in a total of five months (Dec 78 to May 1979, Figure 4).

Technical and economic indicators. As was already noted, assimilation of capacity of the first plant took eight months. Evolution of the basic technical and economic indicators of the plant in this time segment is shown in the table.

We know that in operation of the plant at a load near nominal, technical and economic indicators improve noticeably. Also cited are indicators of the first plant of ChAES for February 1979, where the plant operated with average load rather close to nominal, and reloading of nuclear fuel was done with the aid of an RZM machine.

Generation, million kilowatt-hours	639.5
Average load, MW	955.9
Coefficient, %:	
readiness	99.3
utilization	95.2
Consumption of electrical energy per s.n., %	7.15
Efficiency (gross), %	31.29

The data shown here suggest that power plants with RBMK-1000 reactors can operate for a long period and reliably with planned indicators after a comparatively short period of assimilation of nominal capacity.

Repair service. In under two years the staff of ChAES were able to start-up and successfully assimilate planned capacity of the two power plants (Fig. 5). Experience gained in adjustment and start-up of the power plants with RBMK reactors gives us reason to conclude that the establishment of a unified start-up and adjustment organization will make it possible to concentrate all the primary efforts in AES adjustment and will permit a reduction in the period of assimilation of planned capacity.

A rapid resolution is also required for the problem of creating a centralized repair organization. The level of repair service of ChAES is now too low because of the lack of a head repair organization. Repairs are made through the efforts of several subordinate organizations: on reactor equipment by L'vovenergoremont; on turbine equipment by Kievenergoremont, and also the centralized repair shop existing at ChAES.

The decision of USSR Minenergo to create industrial repair enterprises before 1981, including at the Chernobylskaya AEs, is very timely and vital in this respect.

Conclusions

By 1 Jan 80, the Chernobylskaya AES had generated over 18,000,000,000 kilowatt-hours of electricity since its start-up. It should be noted that reserves for enhancement of the operational level of the plants have not been stripped. The current scheme of operation of one turbine generator to a dedicated 330 kV line to ODU of the Northwest reduces reliability of operation of the plants.

Unfortunately, the situation developing at the Chernobylskaya AES with respect to assuring reliability output of electricity has partially diminished the national economic effect of the early assimilation of planned capacities of the first and second plants. This concerns the lags in construction of the necessary number of VL.

Therefore, one may infer that in spite of individual problems, the staff of the Chernobylskaya AES has performed a great and important task in introducing and assimilating one of the major nuclear power plants in the country.

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ELECTRIC POWER

LENINGRAD NUCLEAR POWER STATION

Leningrad STROITEL'STVO I ARKHITEKTURA LENINGRADA in Russian No 3, Mar 80 pp 3-5

[Article by L. G. Perekrestov, first secretary of the Sosnovyy Bor CPSU City Committee]

[Text] In February of this year, in Sosnovyy Bor, a city of atomic power, the third power unit was completed and put into operation ahead of schedule at the LAES [Leningrad Nuclear Power Station] imeni V. I. Lenin. This great achievement was acknowledged by Leonid Il'ich Brezhnev, who sent his cordial congratulations to the participants of the construction of this station. The final year of the Tenth Five-Year Plan will be marked by the startup of the fourth power unit whose construction and installation of equipment on it are in full swing.

In April 1980 we shall mark the seventh anniversary from the day when, by order of the RSFSR Presidium of Supreme Soviet, the former settlement Sosnovyy Bor, which grew during postwar years, became a city.

It is the youngest city in the northwest of Russia. The average age of its residents today is 26-27 years, which is the Komsomol age. This new city was brought to life by the decision regarding the construction of the Leningrad Nuclear Power Station. Considering its exceptional importance to the national economy, the VLKSM [All-Union Lenin Young Communist League] Central Committee declared the LAES to be an All-Union Key Construction Project.

Komsomol brigades, of which there are over 300, participated in the removal of the first cubic meters of ground from the foundation pit of the future electric power station. Komsomol field teams directed by their headquarters monitored the most important sections of the construction site during the entire period of construction. The third year of the Tenth Five-Year Plan passed under the slogan "outstanding work and excellent training on the sixtieth anniversary of the VLKSM!" The young people of the LAES and Sosnovyy Bor did not spare their efforts in order to mark the 110th anniversary of V. I. Lenin's birthday by fulfilling high socialist pledges.

Let me recapitulate the biography of this nuclear electric power station which is not only the largest in our country, but also in the entire Europe. It was decided to build it here in order to satisfy the needs in electric energy of the rapidly growing industry in the northwestern region, primarily the industry of Leningrad. Economists calculated that, in order to provide fuel for thermal electric power stations equivalent to the LAES in capacity, it would be necessary to supply 11 million tons of coal a year. Its transportation would require at least about 150,000 railroad cars. Large reactors need only a few dozens of tons of nuclear fuel.

It was planned to install at the LAES only two reactors capable of running four turbines with a capacity of half a million kilowatts each. Then it was found necessary by specialists to double its capacity, bringing it to four million kilowatts.

The construction of the first unit of one million kilowatts required about six years. Such nuclear power engineering facilities had never been built before. But, comparing this construction project with analogous nuclear station construction projects abroad, including American projects, it is possible to say that our project was completed about 18 months sooner. This achievement was called another "Russian miracle" abroad.

Leonid Il'ich Brezhnev, Secretary-General of the CPSU Central Committee, sent his cordial congratulation to the builders of the Leningrad Nuclear Power Station on the occasion of their great achievement.

Due to improvements in the organization of labor, the second unit of the first section was ready for operation in four years and ten months. On the initiative of the party coordination headquarters of the construction site, an integrated schedule was worked out, on the basis of which the builders, installers, equipment adjusters, and future operation personnel worked in shifts and sometimes simultaneously observing all safety requirements.

A new victory was won on the eve of the 110th anniversary of V. I. Lenin's birthday: industrial current was produced by the third power unit of the LAES. It took only four years and six days to build it, two-thirds as much as the first unit. And the fourth giant reactor will start operating by the end of the current five-year plan.

Now, Sosnovyy Bor is already delivering the same amount of electric power which all soviet stations were producing in 1932. In only a year, it will be producing twice as much electric energy for the rapidly growing economy of our country. The Leningrad Nuclear Electric Power Station proudly bears the name of V. I. Lenin, through whose insight newer and newer stages in the electrification of our country are being accomplished.

In the designing and construction of the LAES, provisions were made for effective measures of environmental protection. It will suffice to say that the amount of wastes ejected by a nuclear station into the atmosphere is one-thousandth of the amount ejected by traditional thermal stations using coal or mazut. Regular analyses of the water of the Gulf of Finland indicate that there is no radioactive contamination.

The radiation protection control system is exceptionally reliable. Multiply duplicated electronic devices using noncontact elements and information and computation center are constantly monitoring the observance of the prescribed parameters. At the slightest deviation of the parameters, the alarm signal and automatic protective devices are immediately activated. Even the most unusual situations are taken into consideration. Should the need arise, the reactor can be shutdown in a matter of seconds. Provisions are made for radiation monitoring with the aid of remote-control, portable, and individual instruments for the protection of the workers' health.

Apart from scientists and designers, our outstanding builders participated in the creation of this perfect system. On the shores of the Baltic Sea, they created a pilot structure ranking with similar nuclear power stations being built in other regions of the Soviet Union on the basis of the latest achievements of soviet science and technology. I would like to mention the following names among the creators of the LAES imeni V. I. Lenin: superintendent of the construction project Ivan Ivanovich Semykin, Hero of Socialist Labor, a talented organizer and great enthusiast, a tireless and energetic person; skilled installers, brigade foremen who were first in the country to use the contracting method in the construction of large power engineering facilities -- Hero of Socialist Labor and Laureate of the USSR State Prize Aleksandr Andreyevich Pakhalkin, Hero of Socialist Labor Aleksey Ivanovich Kozlovskiy, bearer of two Orders of Lenin Gavril Nikolayevich Mar'yasov, Laureate of the USSR State Prize Mark Nikolayevich Danilyuk; chief operator of the reactor department of the LAES, Hero of Socialist Labor Oleg Igorevich Vitin, who was recently elected deputy of the RSFSR Supreme Soviet, and many other skilled workers and true patriots of our country.

The architects who worked on the creation of the LAES together with scientists and designers tried to give it a modern architectural appearance corresponding to its unique nature. The well-porportioned white-stone buildings fitted very well in the landscape on the shore of the gulf and harmonize with centuries-old pines and the entire environment. The buildings are decorated with Siberian marble, yellowish pink travertine, glazed plates, plastic and film coating, corrugated aluminum, thick stained glass and inlaid panels. The enclosing structures are 12-meter wall panels manufactured at Leningrad plants. They are decorated with light-grey and dark-blue glass covering material.

The scale of the construction of the gigantic atomic power station required a large scale of residential and municipal construction in Sosnovyy Bor. This is why the work is progressing so rapidly not only at the industrial construction site, but also in the city on the shore of the Gulf of Finland which is unique with respect to its natural conditions. According to the plan of economic and social development of the city, over 600,000 square meters of housing and a large number of buildings for domestic and cultural services have already been built.

It should be mentioned that, since the very beginning of the designing, the Leningrad architects, authors of the general plan of Sosnovyy Bor, have been trying to create a harmonious urban invironment. According to their plan, the landscape, yards, public facilities, gardens, and boulevards must meet the growing aesthetic needs of the Soviet people. This problem can be solved only through joint efforts of architects, engineers, builders, artists, and designers. But, of course, it must be solved in an economical way.

With the rapid population growth, it became necessary to build new stores, cafeterias, cafes, and personal services facilities. During the current five-year plan, the following were built: a large department store, "Tallin", two shopping centers, household services facilities, the Palace of Culture "Stroitel'" with a large gymnasium, two secondary schools, SGPTU-236 complex, polyclinic for 1200 outpatients, maternity hospital, children's milk kitchen, automatic telephone exchange for 4000 numbers, bread baking plant, and several preschool institutions.

The citizens and guests of Sosnovyy Bor are grateful for this to the remarkable planning team headed by V. F. Akutin and his colleagues, architects Z. Yu. Paskarenko, V. I. Laponogov, M. A. Beloy, engineers D. S. Molchanov, V. A. Podgornyy, A. G. Shishkov, head of the group of planning supervision, architect G. F. Romanov, architect Yu. T. Savchenko, and many others, as well as to the builders who made their designs a reality. As is known, the designers and the builders of the first microrayon in Sosnovyy Bor were awarded the State Prize of the RSFSR.

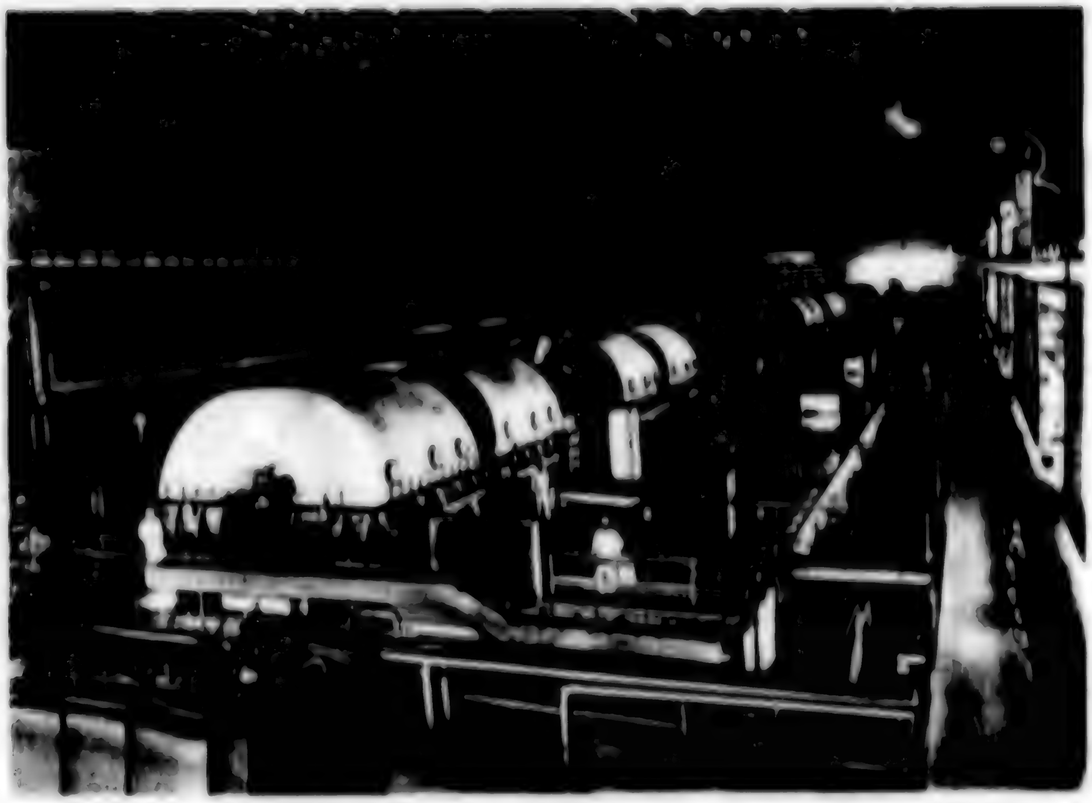
The board of directors of the USSR Architects Union held an on-site meeting at Sosnovyy Bor. They discussed the problem of "Complex Organization of Public Services and Amenities, Planting of Trees, and Design of the City". Why did prominence soviet architects come to our city? Because, as was mentioned by the participants of the forum, they can see and feel the successes of the soviet architecture which is achieving interesting solutions more and more frequently.

Here are the characteristic responses of our guests:

"Fantasies and ideas of the architects and designers are combined with their concern for the preservation of sand dunes and the pine forest", said N. M. Ullas, People's Architect of the USSR and laureate of the Lenin Prize.

"The natural landscape organically blends with the city itself", said A. V. Zhuk, Honored Architect of the RSFSR and laureate of the State Prize of the USSR.

Of course, there were some criticisms, but they were just and kind. It was said that a city like Sosnovyy Bor must have buildings (even if they are built from standard designs!) with some special unique characteristics. It is difficult not to agree with this.

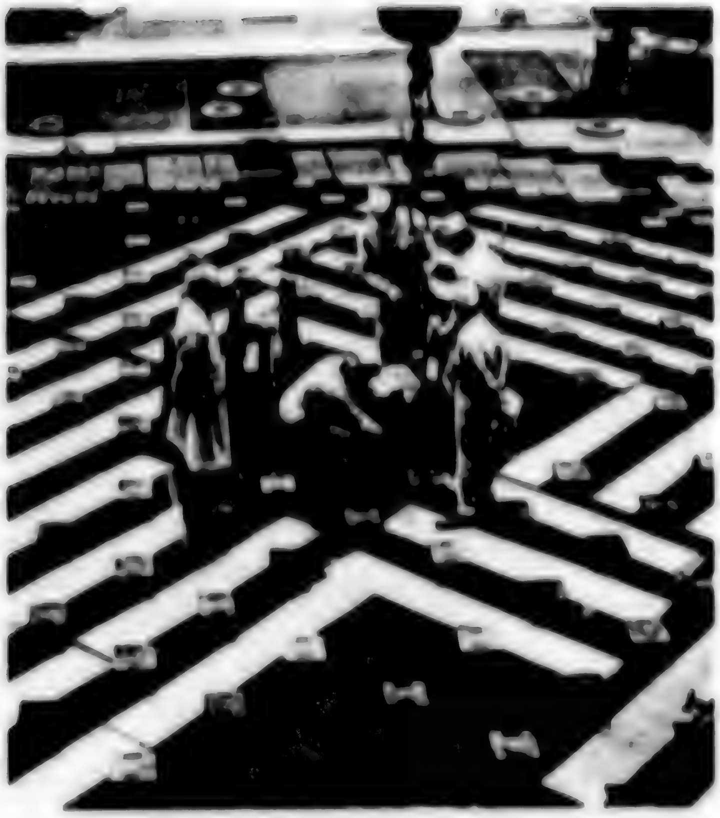


Machine Hall of First Phase of Leningrad Nuclear Power Station

We are building a lot. The initial boundaries of Sosnovyy Bor are already too small for it. Five years ago, they had to be extended. The Oblast Executive Committee included nearby villages and settlements within the city limits. During just one five-year plan, the former microrayons along the Leningrad highway were supplemented by the eighth, ninth, fifteenth, microrayon, and the building of the tenth microrayon was started.

New blocks have to be built under less favorable conditions in swampy areas. The hydrological conditions and the turf covering of sand dunes were often disturbed. Unfortunately, communication trenches have to be redone two or three times. Nevertheless, we are doing our best for Sosnovyy Bor to preserve its beauty and unique closeness to nature.

Work is being done on the development and refinement of a long-range plan for the construction of new residential complexes, prospects, squares, parks, and public buildings. They include, the House of Soviets, Palace of Culture, a 14-story hotel, a large concert hall, House of Newlyweds, and many others. Residents of the city are convinced that the plans for the economic and social development will be materialized, and the architectural projects will become a reality.



Loading First Fuel Assembly into Reactor

The rapid growth of the city which came into being due to the appearance of a unique power engineering complex was naturally accompanied by a rapid increase in the population of Sosnovyy Bor. Members of the families of the builders and operation workers of the nuclear power station also moved to this city. There arose the problem of employment for thousands of people. This is why other industries also started developing: production of agricultural machines, building materials, fish processing, and food industry.

The Sosnovyy Bor Machine-Building Plant, a leading enterprise of the Leningrad Production Association "Kompleks" has an enviable future. The party's policy of the industrialization of agriculture required complex mechanization of animal husbandry and feed production. On the initiative of the Leningrad Oblast Committee of the CPSU, the former Kalishchinskiy Plant of Metal Structures is now specializing in the production of machines and equipment for the mechanization of animal husbandry.

There are some problems connected with the reconstruction of the nearby fish cannery. This enterprise is one of the largest in the association "Sevzapryba". It supplies millions of cans of fish and thousands of tons of smoked fish to the residents of Leningrad. Some of its shops and equipment are outdated and old. It is necessary to build additional buildings and equip them with more productive equipment.

Such is the logic of the economic and social development of new industrial centers. The appearance of a large enterprise unavoidably brings about the appearance of a populated center which begins to live its own life, grows, and improves. It is not without reason that the general plan of Sosnovyy Bor covering 25-30 years provides not only for an increase in the number of residents, but also for their jobs, as well as for the creation of all necessary conditions for their life, education, and relaxation.

The communists and all residents of Sosnovyy Bor will always remember the day of 12 October 1978, when the first party conference of the city took place. Speaking to the delegates, G. V. Romanov, member of the Political Bureau of the CPSU Central Committee and first secretary of the Leningrad Oblast Committee of the party, mentioned the ever-increasing role of Sosnovyy Bor in the development of the country's economy and stated concrete problems for the reconstruction of industrial enterprises, further residential and cultural construction, and organization of public services and amenities of the city.

Today we are aknowledging with satisfaction the practical contribution of our workers into the solution of these problems. During the past years of the Tenth Five-Year Plan, the volume of industrial production almost doubled, and more than 37 million ruble worth of products were produced above the plan. An extensive program of social improvements is being implemented.

A socialist competition under the slogan "From the high quality of work of each worker to a high labor effectiveness of the group!" has spread widely at the enterprises and in the organizations of the city. More than 2500 people will complete their five-year tasks by the day of Lenin's anniversary.

The best results in the competition were achieved by: lathe operator of the machine-building plant of the LPO [Leningrad Industrial Association] "Kompleks" N. S. Grishakov, as well as the team of building decorators headed by A. A. Kartuzova, and the brigade of installation workers headed by G. N. Mar'yasov.

The contribution of the personnel of the Leningrad Nuclear Plant is particularly important in connection with the initiative of five Leningrad enterprises bearing the name of Great Lenin to mark the 110th anniversary of his birthday by appropriate labor achievements. The workers of the LAES pledged to produce from the beginning of the Tenth Five-Year Plan three billion kilowatt-hours of electric energy above the plan by that date. And this promise was fulfilled by the personnel of the LAES who were awarded the Red Banner for their victory in the All-Union Socialist Competition.

The third power unit of the LAES has been completed and put into operation. L. I. Brezhnev, Secretary-General of the CPSU Central Committee and Chairman of the Presidium of the USSR Supreme Soviet congratulated the builders, installation workers, operation workers, machine builders, scientists, designers, and all participants of the construction of the Leningrad Nuclear Station on the occasion of their great labor achievements.

Experiencing the feeling of gratitude and great pride, and responding by their deeds to this congratulation, the workers of our city are determined to make the final year of the five-year plan a year of accelerated work in the Lenin manner.

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ENERGY CONSERVATION

UDC 621.315:681.65.012.2

PLANNING OF ELECTRIC POWER OUTLAYS IN UKRAINE ADJUSTED

Moscow ENERGETIK in Russian No 3, Mar 80 pp 1-3

[Article by A.V. Gritsenko, deputy minister of the Ukrainian SSR Ministry of Power, N.D. Boyko, chief of the planning and economics administration of the Ukrainian SSR Ministry of Power, and Yu.V. Shcherbina, doctor of technical sciences: "Improving Planning of the Expenditure of Electric Power for Its Transmission in Electrical Networks--The Most Important Direction of a Saving of Fuel-Energy Resources"]

[Text] The indicator of the expenditure of electric power for its transport and distribution (losses in the networks) jointly with the indicators of specific expenditures of fuel for release of electric energy and heat practically completely reflect the effectiveness of fuel utilization in the sector.

The dynamics of the indicator of expenditure of energy in the electrical networks of the Ukrainian SSR Ministry of Power is as follows:

Years	Electric power expenditure, %	Years	Electric power expenditure, %
1964	8.92	1972	8.97
1965	8.52	1973	8.69
1966	8.58	1974	8.64
1967	8.83	1975	8.49
1968	8.92	1976	8.92
1969	8.80	1977	8.77
1970	8.67	1978	8.96
1971	8.51		

The relative stability of the indicator considered over the course of an extended period points to the correspondence of the rates of qualitative change in the power systems of the Ukraine to the rates of growth of production and consumption of electric power. A certain increase in the relative expenditure of electric power in the networks in recent years is explained basically by the increasing rates of concentration of the generating capacities owing to introduction of just blocks of 800 and 1000 megawatts, by corona losses in the 750 kilovolt trans-Ukrainian electric power line, and by suboptimal current distribution in the 750/330 kilovolt contours due to the absence of devices for transverse regulation. The introduction of organizational-technical measures with an economic benefit of about 20 million kilowatt-hours per year is required in order to reduce the relative expenditure of electric power in the networks by every 0.01 percent.

The work experience in reducing the expenditure of electric power in the networks of the Ukrainian SSR Ministry of Power has confirmed that the effectiveness of the work depends wholly on the accuracy of long-range and current planning. Lack of validation of the plan quotas inevitably leads to negative results. If a stepped-up plan lessens the enthusiasm of the collective and reduces its initiative in performing the maximum possible number of organizational-technical measures, the unwarrantedly stepped-up plan engenders uncertainty for the collective, it forces a search for ways to adjust the plan, leads to cases of distortion of reporting, and sometimes even to refusal to fight for raising the effectiveness of operation of the electrical networks.

Improvement of planning is the most important direction in the work for saving electric power also because in the process of this work there will inevitably be improvements in the method of accounting and analysis of all the components of the balance of electric power for all the structural levels of administration of the sector, in the methods of planning organizational and technical measures, methods of evaluating effectiveness, and others. The quality of management as a whole will be improved.

In the energy associations of the Ukrainian SSR active work has been done in the past 5-6 years to improve the planning of the expenditure of electric power in the networks. Planning and reporting forms of the balance of electric power for the energy association with a breakdown by enterprises, unified for all energy associations of the Ukraine, were developed and introduced. This has made it possible:

To unify planning and reporting documents;

To submit in a single form the plan and report of the basic factors affecting the expenditure of electric power in the electrical networks;

To insure the accumulation of statistical information necessary for planning and analyzing the balance of electric power, including its expenditure in the electrical networks.

At the present time the planned expenditure of electric power for its transmission in absolute and relative values is submitted in the make-up of the balance of electric power right up to the enterprises of the electrical networks (PES; predpriyatiye elektrosetey). Analogous forms of the balance are introduced according to the PES with a breakdown by regions of electrical networks (RES; rayon elektricheskikh setey).

The balance method of planning and reporting requires the establishment of clear limits of the division between enterprises and between regions, the review and regulation of the placement lay-outs for devices recording electric power, and regulation of the inter-relations between electric power plants, enterprises of the electrical networks and power supply facilities.

The question of the division of responsibility between the dispatcher services and the operating personnel for expenditure of electric power in system-forming networks requires analysis and solution. Remaining a point of debate is the question of where to attribute losses of electric power in the equipment of electric power plants: to the balance of enterprises of the electrical networks, which can in no way affect the value of these losses, or the balance of the electric power plants, which do not have such an indicator in the make-up of the plan.

The report balance of electric power must be compiled monthly not only for each region of electrical networks, but also for the smaller sections, especially the population centers, which are part of it. Otherwise it is impossible to construct an effective analysis of the expenditure of electric power in the networks and to organize the work for reducing it on the basis of an aware search and planning of measures. In particular, compilation of the balances of electric power for the population centers is the only method of detecting commercial losses.

The next stage in improvement of planning the expenditure of electric power in electrical networks in connection with the absence of effective methodical recommendations, formulated in a centralized way, was selection of the method of long-range and current planning of this indicator. It was established that the use of direct reckoning of the total technological expenditure of electric power in the networks with the existing methods and means of collection and processing of data is practically impossible due to the inaccuracy of the initial data and the absence of control of the calculations, the results of which can easily be adjusted by the calculator in any direction. It also proved impossible to divide this indicator into technical and commercial components. Such attempts, as a result of the development of arguments between subdivisions of the energy association reduce the reliability of the calculations and do not facilitate, but rather confuse the work for reducing the expenditure of electric power.

The most applicable was the method of determining the forecasted expenditure of electric power in the electrical networks with the use of a calculation of the deviations of the expenditure from a base value, used for which is the report balance of the previous year or of the corresponding quarter of the previous year. The value of the expenditure of electric power in the networks is divided into direct and alternating components. Deviation of the direct component from the base value is determined by direct counting, which in the presence of information on transformer capacities and electric power lines does not cause great difficulties. The alternating components are determined in proportion to the squares of the ratios of the corresponding items of the forecasted balance to their base values. The coefficients of proportionality in the simplest version of the method correspond to the values of the alternating components of the expenditure of energy in the base period.

For external overcurrents of electric power these coefficients can be determined by direct counting or as the product of overcurrents at the average levels of relative expenditures of electric energy in classes of voltages in which the overcurrents occur, and for internal electrical consumption--as the difference between the summary report expenditure of electric energy, the direct component and the expenditure for external overcurrents.

Such a method of forecasting has five basic assumptions which simplify the calculation.

1. The report balance of the previous year is taken as the reliable base data. In fact it contains different random distortions. More accurate results can be obtained if the base of forecasting is determined by statistical processing of the report information for several years.

2. The dependence of the expenditure of electric power in the electrical network on certain items in the balance can differ substantially from the average value in the corresponding voltage class. More in-depth differentiation of the calculation coefficients is necessary.

3. Excluded from consideration are internal changes in electrical regimes which are not reflected in the deviations of items in the balance. The corresponding error can be reduced by extending the analogous method to regions of electrical networks and smaller sections of electric networks.

4. It is proposed that the overcurrents of reactive capacity change in proportion to a change in the overcurrents of active capacity. In order to reduce this error it is necessary to have balances of the reactive capacity during the hours of maximum and minimum loads.

5. The quadratic dependence of the expenditure of electric power in the networks on items in the balance is an average. In order to refine this dependence it is necessary to know the statistical spread (dispersion) of each overcurrent. An approximate record of dispersions is reached if the corresponding pairs of unbalanced values are used instead of the balanced values of the release or inflow of electric power.

For the purpose of bringing order to the analysis of the indicator of technological expenditure of electric power in electrical networks of the RES, PES, and PEO [possibly, enterprises of energy associations] and for increasing the reliability of planning this indicator, the Ukrainian SSR Ministry of Power in coordination with the republic Central Statistical Administration beginning 1 January 1978 introduced experimental statistical reporting according to form 1-B (losses). This report is submitted quarterly by enterprises of the electrical networks and individual power supply facilities to the energy associations, which in turn summit summary reports to the Ukrainian SSR Ministry of Power. Since form 1-B (losses) is experimental and purely departmental, it is not submitted to local statistical agencies.

The report according to form 1-B (losses) is compiled in the form of a balance of electric power according to classes of voltage. The expenditure of electric power in the networks of each class is divided into alternating and direct parts. The direct part of the expenditure of electric power includes losses in the steel of the transformers, losses on the corona, the expenditure for the in-house needs of the substations and so on. Singled out in the alternating part is the expenditure of electric power connected with the transit of other classes of voltage in the electrical networks, and with its release to the consumers in the given class of voltage. The majority of the data for filling in form 1-B (losses) can be obtained from existing documents of primary accounting, and also from standard reporting forms. An exception is only the information about overcurrents of electric power from a network of one class of voltage to another. However, if the substations are equipped with recording devices in accordance with the Rules for Setting Up Electrical Installations, this information can be obtained according to their readings without especial difficulty.

If the electric meters are inadequate, the value of the overcurrents of electric power between networks with different classes of voltage can be estimated from the readings of the meters installed at lower levels of voltage, and the computed losses in the elements of the electrical network.

The year's experience in using form 1-B (losses) makes it possible to conclude that this reporting will improve in quality from one quarter to the next. It not only increases the accuracy of forecasting the expenditure of electric power in the networks, but also, with a well set-up analysis, ascertains the most overloaded networks, and makes it possible more knowledgeably to plan measures for decreasing their load. The very process of compiling form 1-B (losses) trains the staff to consider carefully the ratio of the values of expenditure of electric power in individual elements of the network and to seek out the potentials of reducing it. A comparison of the indicators for comparable periods makes it possible to conduct work for increasing their reliability, to reveal commercial losses, and others.

A forecast of the deviations in the expenditure of electric power from the base value is possible on the basis of the data of form 1-B (losses). The error rate of the forecast depends first of all on the accuracy of the balance of electric power for the forecasted period. The assumptions accepted above turn out to be fully applicable for forecasting deviations in the expenditure of electric power, since the error from them is commensurable with the error of the forecasted balance of electric power. The positive feature of the method is the possibility of objective adjustment of the plan according to the deviations of the actual balance from the forecast used.

The forecasted expenditure of electric power in the network should be reduced by a certain planned value from introduction of measures for relieving the electrical networks.

The planned value of the expenditure of electric power in the networks is determined in this way.

Using this method it is possible to determine without error the tendency toward growth or reduction in the expenditure of electric power in the networks depending on the structural change in the balance.

A proper approach to evaluating the effect from the measures introduced has especial significance. The procedure in effect at the present time, according to which the planning organization tries to consider the maximum of measures, encounters resistance on the part of subordinate subdivisions, it does not stimulate the enterprises to realization of all reserves. A conscientiously prepared plan for introduction of measures with such an approach will place an enterprise in an unfavorable position in comparison with that enterprise which does not consider in the plan any share of the effect from the measures to be introduced.

It would be more advisable to divide the measures into directive and initiative measures. The category of directive measures should include everything that is envisaged by the plans of capital construction (introduction of generating and substation capacities, electric power lines, compensating devices), and also by the plans of organizational and technical measures approved by higher organizations (replacement of wires, rearrangement and replacement of transformers, introduction of devices for regulation of regimes, and others). All other measures should be put in the category of initiative measures, and the proposed effect from their introduction should not worsen the plan indicator.

In this case all the directive measures will be controlled by the plan for expenditure of electric power in the networks. The initiative measures will comprise the reserve to be expended for compensation of errors in forecasting and for above-plan reduction of the expenditure of electric power in the networks. Systematic conduct of such measures under conditions which do not paralyze the initiative of the enterprise will continuously bring the indicator of expenditure of electric power closer to the optimum level.

It is important that the effect from the directive measures for all enterprises be determined according to a unified method, drawn up on a centralized basis.

Along with calculating the effect from introducing measures to reduce the expenditure of electric power in the networks, it is necessary to consider the possible worsening factors (introduction of new generating capacities at large electric power plants, sharp change in the current distribution of reactive capacities, acceptance of electric power lines of substations from consumers on the balance of the power systems, and so on).

The described method of planning the expenditure of electric power in the networks is applicable only for current (monthly, quarterly and annual) planning. It is still in the stage of introduction, and the success of application will depend in great measure on the recognition of this method by the higher levels of management of the sector. Studies are being done in the Ukrainian SSR Ministry of Power aimed at further refinement and development of the method of current planning of the expenditure of electric power in electrical networks.

In the case of future (long-range) planning for such a large power system as the power system of the Ukraine, it is possible to use the linear dependence of the expenditure of electric power on the release of it in the network with allowances for structural changes in the balance of electric power (internal electricity consumption, transmission of electric power beyond the limits of the power systems, receipt of it from contiguous power systems). The method of making adjustments can be analogous for current planning as well.

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ENERGY CONSERVATION

LACK OF ENVIRONMENTAL PLANNING CITED AT SREDNE-YENISEY GES

Moscow PRAVDA in Russian 23 Jan 80 p 2

[Article by B. Mironov (Krasnoyarsk-Moscow): "Abalakovskiy Argument"]

> [Text] Almost a third of the capital investments in industry go for the development of the fuel-power complex. But in spite of such considerable expenditures, the national economy frequently feels a shortage of fuel and electric power. One reason for this situation is a not fast enough introduction of new capacities and the scattering of forces and money on numerous "uncompleted" facilities. The origin of these shortcomings is often contained in industrial designs and plans. In our opinion, the design of the Sredne-Yenisey GES construction can serve as an example.

"Here is where the dam is to be erected," the pencil stopped on the map just north of the place where the Angara falls into Yenisey." "Here," -- repeated M. I. Nevshupa, first secretary of the Yenisey party raykom, laying the pencil across the blue vein.

Three days later, I saw this place. Captain Anatoliy Vashenin reduced the speed of the launch and, pointing to a bold, rocky spot on the right-hand shore, stated: "It will rest against that rock. The Abalakovskiy section! Here beside it is Abalokovo -- a large sovkhoz..."

The section was selected long ago -- about 20 years back. During that time the Krasnoyarskaya GES was built, three units of the Sayano-Shushenskaya GES were put in industrial operation and the construction of the Boguchanskaya Power Plant began.

The fate of the Sredne-Yeniseyskaya GES, it seemed, had already been decided in 1965. At that time, the USSR Gosplan allowed the USSR Ministry of Power and Electrification [Minenergo] to start developing the design. It was planned to approve the design in 1.5 years so that plant construction could begin in 1971. At that time, there was no doubt of the feasibility of building the Sredne-Yeniseyskaya GES. Besides obtaining 34.3 billion kilowatt-hours of electric power per year and creating a powerful power-industrial region on that basis, the hydraulic center guaranteed the passage of ships over the Yenisey without additional clearing.

It was found, however, that the rich Gorevskoye depost of many kinds of metal ores would be at the bottom of the newly-formed Sredne-Yeniseyskiy reservoir.

How to protect the deposit? At first it was planned to divert the Angara river away from the ore deposit over a new bed. Then an idea was proposed to enclose the ore deposit by a dam. The USSR Ministry of Nonferrous Metallurgy agreed to this version. After the Gorevskoye Deposit stopped interfering with the construction, the Minenergo again began to press for including the Sredne-Yeniseyskaya GES in the active list of construction sites. But how was this persistence justified? We will try and examine this.

Krasnoyarskiy Kray is a gigantic construction site. At present, the Sayano-Shushenskaya and Mainskaya GES are being built here. Since 1975 the "Bratskgesstroy" Trust has been doing preliminary work on the Boguchanskaya GES. The Krasnoyarskaya GRES-2 is being expanded and the Kanskaya TETs is being modernised. Schedules have been set to start up the Beresovskaya GRES-1 and the Krasnoyarskaya TETs-2 and TETs-3 in the very near future.

According to the plan for the Krasnoyarskiy Kray, the Minenergo has the greatest share of capital investments in this kray. Regrettably, all construction sites in this industrial sector lack manpower.

Here is what V. A. Gur'yev, manager of the "KATEK-energostroy" Trust told us: "To cope with this year's program at the Beresovskaya GRES-1, we need to more than quadruple the number of workers. Soon some workers will be freed from Syano-Shushen. If we could only get them! But they tell me: 'they are hydraulic builders'! Yet the narrow specialists among them can be counted on the fingers of two hands, while most of them are skilled in general construction work."

The construction sites of the Kansko-Achinsk complex (KATEK) also feel an acute shortage of equipment. They lack excavators, cranes, large dump trucks and bullgosers. There are frequent interruptions in deliveries of brick, structural metal and lumber. The production base is weak. This is the situation at a facility that is of the highest government importance as stressed in the decree by the Central Committee of the party and the USSR Council of Ministers on creating the KATEK, as well as at the November (1979) Plenum of the Central Committee of the CPSU.

"Need one wonder then about the lack of action at the Boguchany or at the Kureyskaya GES," states G. E. Starovatov, deputy manager of the Construction

Department of the Krasnoyarskiy kraykom of the party." The plan here was shortened many times due to shortages of machines and materials.

What can planners do in such situations? It is dangerous to stop part of the constructions -- people will move away and it is difficult to create a new collective in Siberia. As the saying goes, it is necessary, after having cut away the sleeves, to patch the elbows.

The basic trouble of the Krasnoyarskiy Kray builders today is the scattering of forces and money. It is in this situation that the Minenergo plans to build another giant facility -- the Sredne-Yeniseyskiy GES.

As is well known, in outlining measures for accelerating the putting in operation of production capacities and facilities and raising the efficiency of capital investments, the Central Committee of the party of the USSR Council of Ministers, in their recent decree on improving management, directed planning organs, ministries and departments to reduce sharply the number of new construction sites being started. What right does one have to speak about the Sredne-Yeniseyskaya GES today when there are no free hands, machines or materials in the kray? It means expecting huge resources from the "center." But, forgive us, from what center? If such resources were available they would first be sent to KATEK. And here is the reason.

"This future industrial region of the Krasnoyarsk Kray will consume huge amounts of power," clarified V. A. Ryl'skiy, manager of the Regional Problems Department of the Fuel-Energy Complex of the Council on Studying Production Forces at the USSR Gosplan. "It is sufficient to mention the lumber processing enterprises, petrochemical production facilities and the nonferrous metallurgy plants planned for this zone. They will need constant electric power produced by thermal power plants. The output of hydroelectric plants depends on the water level. It is for this very reason that in such a kray, seemingly rich in power capacities, we feel a shortage of electricity. Paradox? No. This is the result of all the pressure in developing power in the kray being previously exerted only on hydroelectric plants."

This is why there is no one to erect thermal power plants. It is well known that the Sayno-Shushenskaya GES builders will soon be freed. Many of them could be transferred to the KATEK. But, in the kray, it is considered that the hydraulic builders are suitable only for the Sredne-Yeniseyskaya GES. But this hydroelectric plant, even at best, will only be able to provide power in 10 to 15 years. But the country needs the power now. It can be provided by the KATEK. A special feature of the Berezovskaya GRES and her "sisters" that follow her is that they are located in the very rich Kansko-Achinskiy coal basin. The powerful seam, which is up to 100 meters thick in places, stretches almost 800 kilometers. According to calculations by the "Teploelektroproyekt" Institute, the annual output of only the KATEK firstborn, the Berezovskaya GRES-1, will be 43 billion kilowatt-hours!

It cannot be forgotten that KATEK is the basic coal reserve base of the country. The power of its power plants will be used not only in the Krasnoyarskiy Kray, but also to supply the consumers of the Baykal-Amur RR, Western Siberia and, in the future, the European regions of the country and even Central Asia.

It comes out then that KATEK is more important than the Sredne-Yeniseyskaya GES! We would not like to contrast these power plants. It would be well to have both to increase the power potential, but it cannot be because there is not enough of a work force to do both simultaneously.

For this reason, it is very important that power builders move from narrow departmental positions. No matter how much we need power today, we should not look at the Sredne-Yeniseyskaya GES only with the eyes of power people. There is no better compass than checking the correctness of one's actions than by considering government interests. This course should also be taken in this case, and the economic, social and ecological feasibility of building the Sredne-Yeniseyskaya GES should be thoroughly checked out once more.

Yes, the new plant will be able to give the country 34.3 billion kilowatt-hours annually. But what will be taken in exchange? About 400,000 hectares of arable land will be covered by the water reservoir. This, in the most favorable part of the Krasnoyarskiy Kray from the standpoint of climate. The flooded zone contains the best forests of Angara pine in the country, arable lands and 10,670 peasant homes.

"Compared to our neighbors, not so much land will be flooded," stated M. I. Nevakupa, first secretary of the Yenisey party raykom, pointing out the planned flooded area on the map. "But this is the best arable land in our region. It provides our region fully with vegetables. We even export some. After the reservoir is created, we will change from a region which "exports" products to a region which imports products. This is because we will not assimilate other land soon and, really, we do not have much of such arable land..."

According to the calculations of the Kray Agricultural Administration, not only the Yeniseyskiy Rayon, but also six agricultural rayons and 20 agricultural land users will lose valuable land. And this is without taking into account the marshes formed along the "sea." We will not dwell in detail on the fishing problem of the kray. It is obvious that the dam intersecting the river will destroy the fish runs and reduce their spawning.

Fruitful land (and this is in Siberia!), an exceptional forest, fish reserves... Is this not a high price to pay for power? "It is necessary to take into account," states the decree of the Central Committee of the party and the USSR Council of Ministers on improving the management mechanism, "in the technical-economic substantiation of the construction of enterprises and the comparison of the efficiency of the versions of this construction, the economic evaluation of the land sections used for the construction of the enterprises."

However, we may be told -- neither are the thermal power plants blameless -- hundreds of hectares of land turned inside out. They require a great amount of fuel. Atmospheric exhausts are great. True, but there are examples and experience is being accumulated on restoring such lands, cleaning and reducing exhausts while no one can restore flooded arable land.

Our society reached such a stage of development of science and technology where the body of the dam intersects the river itself as a faceted pencil is laid across the river on the map. But let us recall Engels: "We will not, however, brag too much about our victories over nature. It takes revenge on us for each such victory. At first, it is true, each of these victories had the results that we counted on, but in the second and third places entirely different, unforeseen consequences occurred which very frequently destroy the value of the first results... Facts remind us that we are as far from being masters of nature as a conqueror is the master of an alien people... All our mastery over it consists of the fact that we, unlike any other beings, can recognize its laws and can use them correctly."

These are well-known words. However, it is necessary to be reminded of them because perhaps the most surprising thing is that in all the many volumes of plans, inquiries and conclusions on the Sredne-Yeniseyskiy GES, there is not even one chapter on the effect of the new power plant on the environment.

The problem of building the hydraulic center has extensively affected the interests of many industries: mining, fishing, forestry, agriculture, the river fleet... This problem goes far beyond the framework of power engineering. Only an expert government commission, capable of protecting general national economic interests, is capable of solving the problem. Such a commission, consisting of specialists from all interested departments, and only it, must dot the i's in the prolonged Abalakovskiy argument.

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FUELS

GEOLOGISTS CLAIM SUCCESSES IN MEETING COUNTRY'S NEEDS

Moscow PRAVDA in Russian 6 Apr 80 p 1

[Interview with USSR Minister of Geology Ye. A. Kozlovskiy: "Always Searching"]

> [Text] Soviet explorers of the earth's depths are having their vocational holiday. PRAVDA's correspondent asked USSR Minister of Geology to tell about the work of the branch's laboring collectives last year and about the tasks they are now tackling.

"Last year was not easy for us," said the minister. "A growth in explored reserves that greatly exceeded the indicators for 1978 was specified for a majority of the minerals. The geologists coped with this task. Reserves of natural gas, iron ore, molybdenum, zinc, tungsten and others increased more than planned.

"Prospects for West Siberia's oil and gas bearing province--the country's main base for raw materials for power engineering--expanded greatly. Here, exploration of a number of large fields was completed, and new promising oil and gas reserves were discovered. Oilfields on the Buzachi Peninsula in Kazakhstan were prepared for industrial development, prospects for finding gas in the Dauletabad-Donmez region in Turkmenia were expanded, and coal reserves at the Kansk-Achinsk, Turgay, Donets, Kuznetsk, South Yakutia and other basins were expanded. In the BAM [Baykal-Amur Mainline] zone, exploration of some fields that will be bases for regional production complexes and industrial clusters has been completed.

"Scientific-research organizations have completed important work on making up a series of maps of forecasts for the main types of minerals in the USSR. Information from high-altitude aerial and space surveys were used widely in geological research. Improvement of geological, geophysical and geochemical methods of prospecting for minerals continued.

"All this is the result of the work of many thousands of explorers of the earth's depths. The highest indicators were achieved by the brigades of

USSR State Prizewinner M. Avramets of Poltavneftegazrazvedka [Association for Oil and Gas Exploration in Poltavskaya Oblast], V. Gubin of the Irkutsk Geological Administration, USSR State Prizewinner A. Nitsak of the Irkutsk administration, and Kazakh SSR State Prizewinner I. Dontsov of Sevkazgeologiya [North Kazakhstan Geological Administration] of Kazakhstan's Ministry of Geology, and many others.

"The geologists and geophysicists on whom the title, "Honored Explorer of the Earth's Depths," was conferred recently made a great contribution to development of the country's mineral raw-materials base.

"The explorers of the earth's depths face important tasks during the concluding year of the five-year plan. They must not only meet the goals of this year and the five-year plan as a whole but also create a backlog of started work for successful operation during the Eleventh Five-Year Plan.

"Raising the effectiveness of prospecting work, especially in regions where there are mining enterprises that are inadequately provided with raw materials remains one of the main problems. We attribute the greatest importance to scientific and technical progress and to the validity of forecasts and the pinpointing of locations.

"Soviet geologists are doing everything possible to achieve new successes in carrying out 25th CPSU Congress decisions to further expand the country's base of mineral raw materials."

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FUELS

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COMPUTER PLANNING OF THE URENGOY GAS FIELD

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 pp 14-16

[Article by P. F. Burakevich, N. D. Astakhov, V. Ye. Veselovskiy, A. V. Zlotov, G. I. Ivanov, A. G. Kovalenko, I. A. Krylov, I. Kh. Sigal, V. R. Khachaturov]

[Text] The planning of the Urengoy field has been quickly accomplished by using a computer. Out of all possible versions for introduction, plan No. 8 is recommended -- it is the best with respect to metal consumption among the plans with the UKPG[1] in the fields explored in detail.

The Urengoy field is the primary raw material base for the development of the gas industry in the tenth five-year plan and the future. According to the development plan, the annual gas extraction from the fields must reach 100 billion m^3, and the maximum possible is 200 to 300 billion m^3.

Beginning with this fact, when planning the Urengoy field two versions of gas extraction were considered -- 100 and 200 billion m^3/year.

In order to choose the plan by computer with extraction of 100 billion m^3/yr, the following basic initial data were year: the number of gas wells -- 490 in 94 clusters; places for possible construction of UKPG -- 49, including 23 sites explored in detail, and 26 indicated by the planning institute by the results of analyzing the cartographic material; well flow rate 1 million m^3/ /day; gas extraction by years of the planning period (1978-1994); output capacity of the UKPG from 2.5 to 20 billion m^3/year; constructed sites -- 3 UKPG and the highway planned by the VNIPIgazdobycha Institute; permafrost map of the field with indication of forbidden zones for laying gas mains and building roads; topographic map of the field; normative data with respect to the cost of pipe and equipment.

Out of all of the plans calculated on the computer, 12 plans were selected. They had numbers 1, 2, 3, 4, 8, 9, 10, 11, 12, 13, 14 and 16.

The criterion for selecting these plans was the cost of construction, which is the capital expenditures on UKPG with cooling stations, gas compressors, gas collecting networks, gas mains and roads (without considering the planned highway) summed for the planning period.

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[1] complex gas preparation installation.

Another criterion was metal consumption of construction which was made up of the metal consumption of the gas collecting networks and the gas mains.

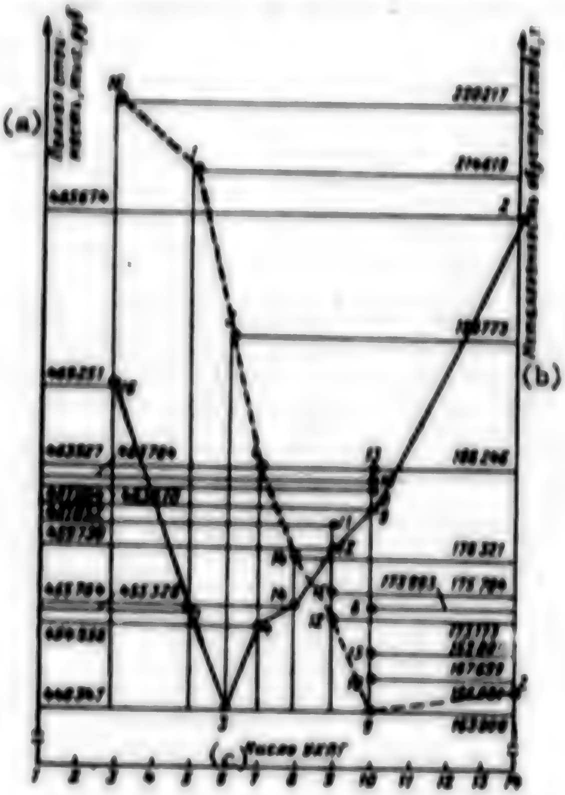

Figure 1. Cost and metal consumption and construction as a function of the number of UKPG when extracting 100 billion m^3 of gas per year.

Key: a. total cost, thousands of rubles
b. metal consumption of construction, tons
c. number of UKPG

By the criterion of cost of construction, plan No 3 is optimal, and plans Nos 1, 4, 8, 9, 10, 11, 12, 13 and 14 are close to it. By the criterion of metal consumption, the optimal plan is No 9, and Nos 2, 3, 4, 8, 10, 11, 12, 13 and 14 are close to it.

In eight plans Nos 2, 4 and 9-14) there are UKPG which are not located in the sites that have been explored in detail. For these plans additional expenditures are required which are connected with exploration of the sites for which the placement of UKPG is planned.

The given situation leads to the fact that for further analysis it is meaningful to compare the selected 12 plans with one of the plans in which all of the UKPG are located at sites that have been explored in detail.

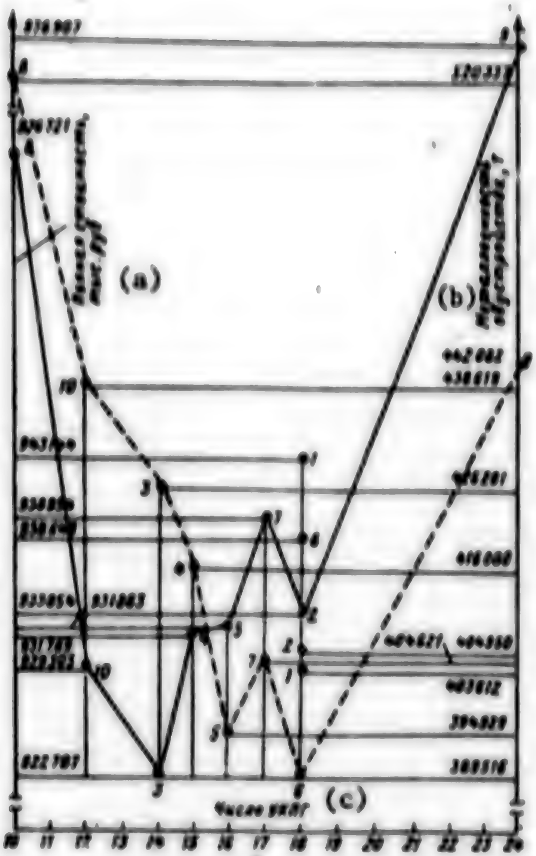

Figure 2. Cost and metal consumption of construction as a function of the number of UKPG when extracting 200 billion m^3 of gas per year.

Key:
- a. total cost, thousands of rubles
- b. metal consumption of construction, tons
- c. number of UKPG

Figure 1 shows the cost and metal consumption of construction as a function of the number of UKPG. The solid line corresponds to the cost, and the dotted line corresponds to the metal consumption; the numbers indicate the numbers of the selected plan.

On the basis of analyzing the data presented in Figure 1, the conclusion is drawn that the plan No 8, all 10 UKPG of which are located on the sites that have been explored in detail differs from plan No 3 by a total of 3.1%, and from plan No 9 (with 10 UKPG) by 6.3%. In addition, plan No 8 is the best with respect to metal consumption among the plans with UKPG in the sites explored in detail.

Accordingly, when selecting the plan for further analysis connected with transition to gas extraction in the amount of 200 billion m^3/year, it is expedient to compare the 12 selected plans with plan No 8[1].

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[1] See the figure in the article by V. R. Khachaturov, et al., published in No 3 of the journal for 1979.

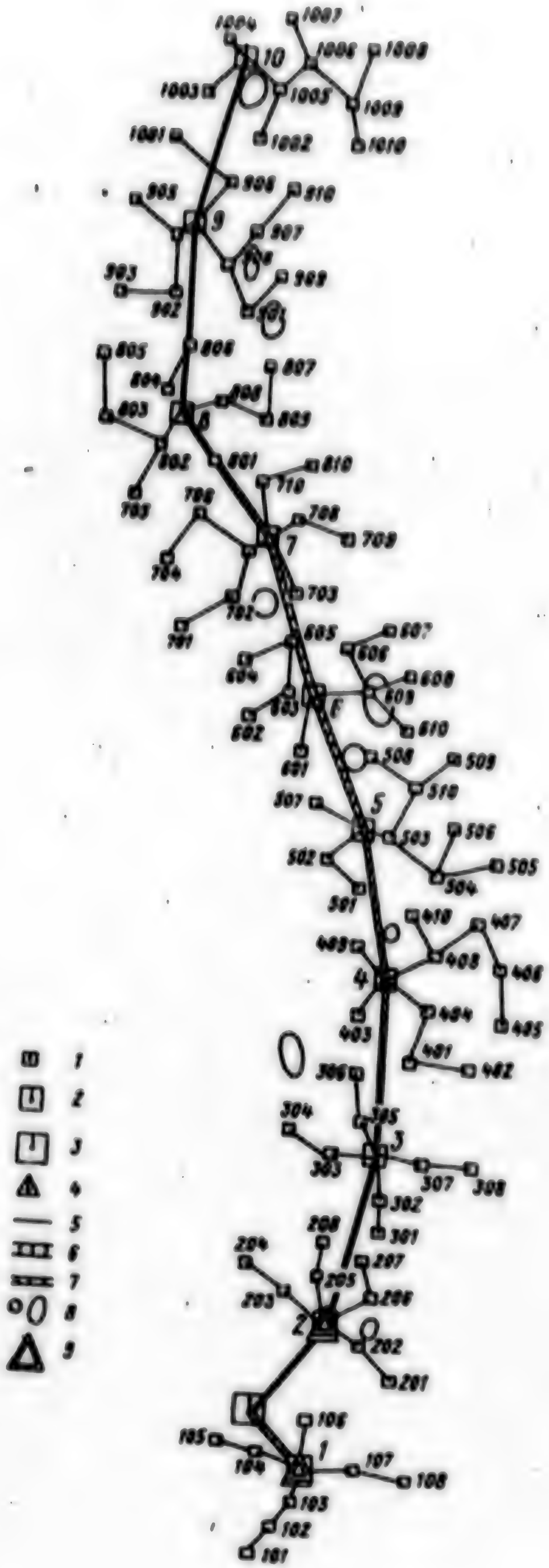

Figure 3. Construction plan for the field with the UKPG in clusters. 1 -- clusters of wells with UPG[1]; 2 -- locations of possible booster compressor stations; 3 -- head structures; 4 -- points for joining the field roads to the interfield road; 5 -- gas gathering collecting main; 6 -- gas transport collecting main; 7 -- automobile roads and intersection points; 8 -- forbidden areas for laying gas mains and roads; 9 -- booster compressor stations.

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[1] gas preparation installation.

Cost and metal consumption of construction for the plans for 100 billion m^3/year extraction with gas preparation installations in clusters.

Indexes	Plan						
	$\frac{1}{8}$	$\frac{2}{9}$	$\frac{3}{10}$	$\frac{4}{11}$	$\frac{5}{12}$	$\frac{6}{13}$	$\frac{7}{14}$
Total cost of construction, thousands of rubles	350,693	350,969	352,321	352,436	351,146	352,903	348,746
Metal consumption of construction, tons	165,764	160,319	163,341	167,575	165,074	166,870	165,533

Note. In the numerator is the number of the plan with UPG [gas preparation installation] in clusters; in the denominator is the number of the plan with UKPG [complex gas preparation installation].

The plans Nos 3, 4, 8, 9, 11, 12 and 14 were selected for further analysis. For them the metal consumption of construction does not exceed the values of these indexes for plan No 8.

With computer planning of the Urengoy field when extracting 200 billion m^3 of gas per year, the same initial data were used but considering 157 clusters.

Out of all the construction plans calculated on the computer, 10 were selected (Nos 1-10). The criteria for their selection were also cost and metal consumption of construction.

The optimal plan with respect to the cost criterion was No 3, and close to it were Nos 1, 2, 4, 5, 6, 7 and 10. With respect to the metal consumption criterion the optimal plan was No 6, and close to it were Nos 1-5, 7 and 10.

In nine plans (Nos 2-10) there are UKPG not located in sites explored in detail, which requires additional expenditures.

Figure 2 gives the cost and metal consumption of constuction as a function of the number of UKPG. The provisional notation is the same as in Figure 1.

It must be noted that plan No 1, 18 of the UKPG of which are located on sites that have been explored in detail differs from plan No 3 by only 2.2%, and from plan No 6 (also with 18 UKPG) by a total of 3.6%. Therefore the 10 selected plans were compared with plan No 1.

For further analysis connected with the transition to the extraction of 200 billion m^3/year, out of 10 plans, six plans were selected (Nos 1-6), the total cost and metal consumption of the construction for which do not exceed the indexes for plan No 1.

The choice of the exploration versions was made so that the plan for 200 billion m^3/year coincided with the plan for 100 billion m^3/year in the extraction section for 100 billion m^3/year.

This condition was satisfied by four pairs of plans which define four versions of the exploration of the field: Nos 4, 14; Nos 5, 12; Nos 6, 9; Nos 1, 8.

The final choice of the versions of exploitation of the Urengoy gas field can be made with additional analysis of the versions with respect to a number of other indexes (manpower, material resources, and so on).

Machine planning has also been carried out in order to discover the cost benefit of using the gas preparation installations (UPG) in clusters.

Out of the calculated 12 plans, 7 were selected (Nos 8-14). The locations of the UKPG were taken as the possible compressor locations.

The problem consisted in optimizing the gas line networks and selecting the locations of the compressors, their types and the number of them. After solution of these problems, plans with UPG in clusters (Nos 1-7) were obtained. The system drawn by the computer for collecting and transporting the gas in plan No 1 with UPG in clusters is shown in Figure 3.

In order to estimate the cost benefit of using the UPG in clusters for the cost of construction for the 100 billion m^3/year plan, the cost of construction was calculated for the corresponding plan with UPG in each cluster. The plans with UPG in clusters turned out to be cheaper than the corresponding plans with UKPG (see the table).

Thus, the transition to the gas preparation insulations in clusters is economically effective. The cost of the plans with the UKPG exceeds the cost of the corresponding plans with UPG in clusters by more than 100 million rubles (for a cost of 1 UPG of 1,780,000 rubles). Here the plans with UPG in clusters are cheaper than the corresponding plans with UKPG until the cost of one UKPG drops by 11.1 million rubles. With a reduction in cost of the UKPG by more than 13.4 million rubles the plans with UPG in clusters become more expensive than the plans with UKPG.

Thus, for the existing cost of the UKPG the plans with UPG in clusters are effective until the cost of 1 UPG exceeds 2.9 million rubles.

In addition, a decrease in metal consumption of construction takes place.

Conclusions

With respect to the criterion of the total cost of construction, a trend has been noted toward enlargement of the UKPG. When extracting 100 billion m^3 of gas per year the number of UKPG approaches 6-8, and when extracting 200 billion m^3/year it approaches 14.

By the criterion of metal consumption of construction there is a trend toward an increase in the number of UKPG. When extracting 100 billion m^3/year the number of UKPG approaches 10, and when extracting 200 billion m^3/year it approaches 18.

By both criteria the best plans are Nos 3, 4, 9, 11, 12, 14, 8 (when extracting 100 billion m^3/year) and Nos 1-6 (when extracting 200 billion m^3/year).

Considering the process of exploiting the field, the following versions of development are preferable: from plan No 14 for 100 billion m^3/year (8 UKPG) to plan No 4 for 200 billion m^3/year (15 UKPG); from plan No 12 for 100 billion m^3/year (9 UKPG) to plan No 5 for 200 billion m^3/year (16 UKPG); from plan No 9 for 100 billion m^3/year (10 UKPG) to plan No 6 for 200 billion m^3/year (18 UKPG); from plan No 8 for 100 billion m^3/year (10 UKPG) to plan No 1 for 200 billion m^3/year (18 UKPG).

An alternative solution is the transition from the UKPG to the gas preparation units located at each cluster of wells.

As a result of analyzing four of the versions recommended by the computer for exploiting the Urengoy gas field the VNIPIgazdobycha Institute selected plan No 8 for 100 billion m^3/year.

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UDC 622.279.23/.4:338.2

GAS FIELDS TO BE DEPLETED AT SLOWER RATE

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 pp 10-13

[Article by I. S. Tyshlyar]

[Text] The replacement of the forced method of assimilating the gas pools by the long-range programs for working the fields is a realistic path to achieving high final production results of the branch.

The high rates of development of the national economy of the country, the growing complexity of the problems of assimilating new gas pools, especially those located in uninhabited areas with severe climatic conditions, along with the exploitation of a large number of old, to a significant degree already depleted fields require further development of the theoretical principles and methods of development pertaining to the optimization of the gas extraction considering the requirements on environmental protection.

According to the calculations of the scientists, the high rates of development of industry will also be maintained in the forthcoming years. In the last 15 years the population of the country has increased by almost 20%, and the extraction and production of gas have more than tripled. In the opinion of academician N. V. Mel'nikov, it is possible to talk about an "explosion" in the demand for mineral resources.

The limited nature in the period of the industrial reserves of natural gas estimated at 3 to 5% of the total fuel and energy reserves, and the constantly growing expenditures on prospecting, extraction and transportation of them require more effective economic methods of substantiating the long-range planning decisions based on growth of the final production results.

By an increase in the final (total) production results in the gas industry we mean the development system which will insure the optimal proportion of participation of each field in covering the demand of the national economy for gas, an increase in the coefficients of gas and product extraction for the entire time of working the fields and complete (calculated) loading of the capacities over the extent of the longest possible economically substantiated period of stable gas extraction. This type of working of the fields must be distinguished by minimum losses of social labor and natural resources with the least total reduced expenditures (for prospecting, extraction, transportation and refining the gas), insuring maximum national economic effect from the sale of the primary components and by-products.

The great advantages of oil and gas over other forms of fuel and raw materials, the relative closeness of the large users to the oil and gas pools combined with difficulties of the postwar period in our country have led to the forced working of the most effective resources which was justified at the time when many enterprises were supplied with coal.

At the present time the economic possibilities of the USSR have increased significantly. The economic strategy of the CPSU which is embodied in the 10th Five-Year Plan proves the concentration of planned activity on the achievement of high final production results. The course to more efficient use of oil and gas is the long-term assignment recognized to increase the yield of the most important final products from refining the raw material.

In the resolutions of the All-Union Economic Conference on "Increasing the production efficiency in the gas industry in the light of the resolutions of the 25th Congress of the CPSU" (Orenburg 23-26 August 1976) it was noted that in the tenth five-year plan the gas industry appeared as a new phase in its development characterized by high production growth rates, further stressing of the intensive methods of management and more complete utilization of the entire economic potential of the branch."

The problem of a more efficient approach to the use of the natural wealth of the country was so sharply stated because the forced depletion of large fields which has played a positive role in a defined phase of development, under the new conditions of sharply growing scales of consumption, growing production costs and world (export) prices for gas, turns out to be less effective by comparison with the application of the long-range programs for working the pools (with a prolonged period of stable extraction, higher productivity of labor and loading of the capacity used).

As the transition is made to the assimilation of larger and larger fields with respect to gas reserves, the optimal solutions have shifted to the area of moderate annual extraction. For example, when working the Severo-Stavropol'skoye, Shebelinskoye and Gazlinskoye fields the annual extractions were 6-7% of the initial reserves, and when substantiating the optimal version of working the Medvezh'ye field, 4.2%. The economic indicators show that in the future the process will be more and more intensified, prolonging the period of stable extraction and realization of the future interests of the country with more complete use of the economic potential of the branch.

The conversion to long-range programs of working the field must be accompanied by stable support of the growing demands of the country for gas at the expense of leading development of the geological prospecting work (GRR) and increasing the number of uniformly worked fields. The indicated measures are being realized already to a defined degree in the gas industry [3].

The organization of the extraction and transportation of gas is, as is known, coupled with the assimilation of enormous capital investments. However, the level of use of the created capacity in the process of developing the gas fields is subject to relatively fast change, especially for the forced rates of the working of the gas reserves. The factors of subsequent depletion of the fields are reflected not only in the efficiency of using the production capacities, but also in the relations between the extraction of the gas and the increase in new reserves throughout the branch as a whole achievable by ever-increasing expenditures.

When evaluating the various versions of the long-range planning in the gas industry, significant interest is aroused by the comparison of the growth rates of the raw material base of the branch with the growth rates of the foreign (export) prices for gas. Thus, whereas the increase in the gas reserves of industrial categories from 1974 to 1976 was 9.1% in our country, the growth of export prices for gas exported from the USSR during the same period reached187.2% [1, 2], that is, it led the rates of increase in reserves by more than 20 times. Accordingly, the incentive is becoming more intense for growth of reserves and introduction of new gas pools previously appearing to have low effectiveness.

Under the conditions of the effect of the noted trends, the versions of the forced extraction of gas with a short stable extraction period of it and sale with respect to relatively low wholesale prices are becoming economically disadvantageous, for this will in the final analysis lead to failure to obtain a significant effect.

As the calculations show for leading rates of increase in export prices over the increase in new industrial reserves of gas, the optimal solutions will become those which lead to an increase in the stable extraction period and more complete extraction from the created capacities. Under these conditions a new methodology substantiating the transition to long-range planning programs forworking the largest fields of the country is acquiring extremely important significance.

The most urgent methods in the economic theory of the gas industry are the methods of considering the replacement expenditures, the time factor and efficient levels of annual gas extraction determined on the basis of developing a systems approach in planning.

Reference [4] substantiates the necessity for considering also the environment in the criterion of replacement expenditures providing for continuity of production as a result of restoring the disturbed equilibrium of the industrial gas reserves with the extraction. By the replacement expenditures on the geological prospecting work and environmental protection we mean specialized investments economically providing for restoration of the disturbed equilibrium.

When optimizing the design solutions with respect to working the gas fields for the period of constant extraction (or for the time of extraction of the basic gas reserves) the differences in the final gas extraction coefficients have not found reflection in the criterion, for identical payment for geological prospecting work with respect to all versions had no effect on the selection of the optimum. Therefore, they were not taken into account in the comparative estimate of the versions. When investigating the versions of the working of the fields for the entire exploitation time, the differences in the final gas extraction coefficients made it possible to consider the qualitative characteristic of the planning solutions with respect to the final production results and to make a unique determination of the economic advantage of reducing the gas losses and the losses of the by-products.

As is known, the solution of such problems as the proportional development of social production is connected with the saving of social time, efficient use of manpower, material and natural resources. The greater the capital investments made in metal and concrete of the industrial-productive capital, the greater the significance acquired by comprehensive consideration of the time factor when making a comparative estimate of the long-range planning solutions.

All of the methods existing at the present time for considering the time factor for the comparative evaluation of the versions, in the opinion of T. S. Khachaturov, began with continuous growth of the productivity of labor of the workers of material production and with new means of labor leading to reduced cost of the unit production and, hence, with inequality of the identical expenditures of labor realized at different times [5].

In order to reduce the versions distinguished by difference in time and magnitude of expenditures to the same, primarily the initial time, the method of discounting expenditures has become widespread which is defined by the formula of complex percentages and $E_{H.\pi} = 0.08$.

These theoretically correct principles for the processing branches of industry were reinforced in the Standard Procedure as a defined achievement of theory with respect to accounting for the time factor and they have been extended to the extracting branches of industry. Using these principles, the total capital investments K_{total} for the entire time of working the gas deposit T reduced to the first year are defined by the formula

$$\underset{(a)}{K_{\text{общ}}} = \sum_{t=1}^{T} \frac{K_t}{(1+E_{\text{нп}})^{t-1}}, \qquad (1)$$

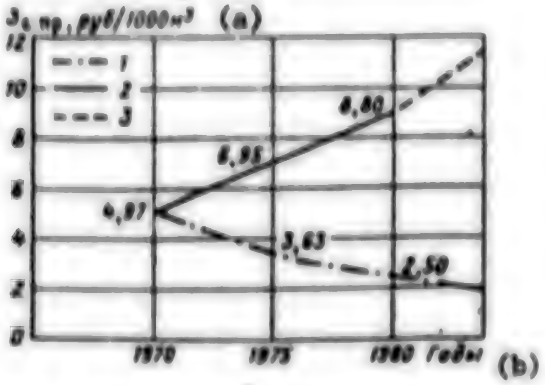
Key: a. total

where K_t are the capital investments in the tth year; $E_{H.\pi}$ is the coefficient of different timing of expenditures.

The total operating expenditures are determined similarly.

Using the method of discounting the expenditures at different times, many researchers have already turned attention to the fact that the actual changes in the cost of production units even in the processing industry do not coincide with the indexes which must be obtained when using the formula of complex percentages and the adopted normatives $E_{H.\pi}$. The noted remark is valid to an even greater degree for the gas industry where the mining-geological conditions are gradually becoming more and more complicated, involving not a reduction, but an increase in the unit production cost.

The data presented in the figure indicate that the actual, planned and predicted reduced expenditures on prospecting, extraction and transportation of 1000 m^3 of gas throughout the country are increasing in time. On the average for 10 years the reduced expenditures of the latest period exceed the expenditures of the preceding period by 1.77 to 1.80 times.



Variation of the reduced expenditures on prospecting, extraction and transportation of gas in the USSR. 1 -- for traditional accounting for the time factor; 2 -- actual and planned.

Key: a. rubles/1000 m^3 b. years

Nevertheless, in the planning practice of the fuel industry when calculating production cost, the characteristic features of mining production are not taken into account, and consequently, the actual conditions of the working of the gas fields are not taken into account.

Indeed, the productivity of labor in the gas industry increases only for leading rates of gas extraction over the rates of investment of means, and thus, depending on the adopted levels of annual extractions, occurs only over the extent of depletion of the greater part of the reserves of the fields. Then as the field is depleted no provision of labor with capital will make it possible to overcome the reduction in the efficiency indexes of the working of the depleted fields.

In order to maximize the productivity of labor over the entire exploitation time, the capacity for extracting and transporting gas must be optimized beginning with the final production results and the actual consideration of the time factor.

In the figure, curve 1 reflects the traditional consideration of the time factor and is constructed using the function $1/(1 + E_{\text{н.п}})^{2-1}$, and curve 2 corresponds to the function $(1 + \eta)^{t-1}$, where η is the coefficient of increased cost of the product.

On the basis of the data in the figure, a coefficient of increased cost is selected which amounts to $\eta = 0.06$, which, considering the growth of productivity of labor in the gas use system by 1-2% on the whole throughout the national economy can be taken approximately within the limits of 0.04-0.05 for the future.

The proposed value of the coefficient was obtained on the basis of using the trends in the variation of basically the mining-geological conditions of production in the gas industry of the country and is temporary. The author does not claim to a final, established value of the coefficient η, but its consideration at the present time decreases the errors and the "roughness" of the forecasting calculations, and it intensifies the attention on the peculiarities of the mining production.

Considering the increase in prices for gas and gradual complication of the mining-geological conditions of production in the gas industry it is proposed that this objective phenomenon be reflected in the procedure for considering the replacement expenditures when determining the completeness of extraction of the product from the depths. For this purpose it is necessary to base the calculations not on the decreasing cost of the reproduction of mineral resources, but an increase in value

$$З_{\text{ср. воспр}_i} = \frac{З_{\text{уд. ст}_i} \sum_{i=1}^{m} \sum_{t=1}^{T} (1+\eta)^{t-1}}{T}, \qquad (2)$$

where $З_{\text{ср. воспр}_i}$ are the mean replacement expenditures per production unit for each component from i to m; $З_{\text{уд. ст}_i}$ is the specific starting value of the reduced expenditures on geological prospecting work for each component.

The reflection of the increasing cost of replacement of the new gas resources and by-products in the comparative effectiveness of capital investments solves the most important problem with respect to shifting the optimums to the region of reducing the losses of hydrocarbons.

On the whole, throughout the national economy the increase in the capital available to labor leads to an increase in its productivity. This is the basis for the progress in social production. Along with complication of the mining-geological conditions, this prerequisite also is in effect in the gas industry. For example, the transition to cluster placement of the wells, an increase in the stable extraction period, an increase in the diameter of the gas lines, regulation of the combustion processes, an increase in the proportion of the gas used a raw material for the chemical industry, and so on lead to an increase in the productivity of labor.

Consequently, within the elements of the gas industry connected with extraction, transportation and the use of the gas, integral (total) consideration of the time factor is required. Then the formula for considering the total capital investments varies as follows:

$$\underset{(a)}{K_{\text{сов}}} = \sum_{t=1}^{T} \frac{K_t(1+\eta)^{t-1}}{(1+E_{\text{нп}})^{t-1}} = \sum_{t=1}^{T} K_t A_t, \qquad (3)$$

Key: a. total

where $A_t = \frac{(1+\eta)^{t-1}}{(1+E_{\text{нп}})^{t-1}}$ is the index of integral consideration of the time factor permitting optimization not only of the construction rates of the fields, but also the rates of working the reserves.

Conclusions

The necessity for making the transition to a new economic strategy for the working of the gas fields and replacement of the forced methods by long-range programs for working the fields with prolonged stable extraction periods arises from the increase in the final production results with rising export prices for gas, an increase in the efficiency of the use of social labor as a a result of introducing some capital-saving recommendations and improving the entire economic potential of the branch.

In order to substantiate efficient programs for working the fields in the branch, an integral criterion has been developed and is introduced in which the new method of accounting for the replacement expenditures, the time factor and efficient levels of annual gas extractions determined on the basis of developing the systems approach in planning are reflected.

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CSO: 1822/59

FUELS

EXTENSION OF ORDZHONIKIDZE-TBILISI GAS PIPELINE COMPLETED

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 pp 7-8

[Unsigned Article]

[Text] The Ordzhonikidze-Tbilisi gas pipeline built 20 years ago is a unique structure. Its route lies along the spurs of the Greater Caucasus Ridge at an altitude from 500 to 2500 meters above sealevel. The gas line is operated under extremely complex conditions: frequent avalanche-like soil shifts, mud flows, snow avalanches, prolonged, thick snow cover, "wandering" mountain river channels and a number of other phenomena often create the danger of disrupting the normal gas supplies of the Georgian SSR.

The experience in the operation and maintenance of the gas line has proven that along with repair and maintenance operations it is necessary to build additional capacity permitting the output capacity and the reliability of the fuel main to be increased, especially during the fall and winter months.

The creation of new facilities for the gas industry is usually the business of adjacent construction branches which in recent times have assimilated more than 5 billion rubles of capital investments annually and no less than 2 billion m^3 of construction and installation operations.

A characteristic feature of the expansion of the Ordzhonikidze-Tbilisi gas line system consisted in the fact that all of the required construction, installation, startup and adjustment operations had to be performed by the forces of the Ministry of the Gas Industry alone. On 10 May 1979, by order of the ministry this construction site was declared a shock site.

The realization of the goal was put in the hands of the "Kavkaztransgaz" and "Gruztransgaz" associations with the rights of customers, the VNIIPIgazdobycha Institute as the master planner, the Soyuzgazifikatsiya Production Association as the general contractor. The time alloted for construction of the new projects did not exceed 5 months. The complexity of the route of the gas line, the presence of the Voyenno-Gruzinskaya road (VGD) in the corridor and the presence of other engineering communications complicated the choice of sites for the compressor stations and the adoption of engineering designs.

The initially planned volume of capital investments in building the compressor stations was more than 9 million rubles. A significant part of these expenditures were connected with the large volume of preparatory earthwork (300,000 m^3).

The search for the optimal version in order to reduce the labor intensiveness and capital investments in construction as much as possible was made not only in the offices and laboratories. The minister of the gas industry S. A. Orudzhev and his deputy S. S. Kashirov participated in reconnaissance in the field.

The sites for the compressor stations were determined in the vicinity of the villages of Chmi and Kvesheti at an elevation of 1820 meters above sealevel near the VGD road in terrain with relatively mild relief. The volume of the earthwork was reduced by 250,000 m^3. The optimization of the final solutions made it possible to reduce the capital investments by more than 1 million rubles and to bring the labor consumption of construction to an amount providing for fulfillment of the assignment in the established time.

Considering the limited nature of the individual types of material resources in the construction zone, the decision was made to compensate them by the maximum use of the local possibilities without reducing the strength of the structures and their quality.

Thus, for example, about a thousand cubic meters of lumber was required to line the gas lines in the rocky ground. A substitute for them was found locally by applying finely ground dolomite for constructing the cushion and filling around the pipe.

As the foundations under the block boxes and the process blocks the decision was made to use fills of crushed rock instead of the short reinforced concrete. The decision was made to lay the oil systems without ditches, building thermal elements into the common insulating shell. Many reinforced concrete structural elements were replaced by metal.

All of the structures, including the GPA-Ts-6,3 turbine gas transfer units at the compressor stations were made modular-complete.

The intensive labor fell to the lot of the administrations of material and technical supply and equipment outfitting. All of the problems of mobilizing reserves were resolved in the shortest possible time. Pipe, metal, cement, fuel and lubricants, fittings, turbines, instruments and other equipment arrived at the sites in a continuous flow.

The work of the VNIPIgazdobychi designers working by the method of field planning and design proceeded in parallel. Their decisions were implemented by the builders and installation workers of the Tselingazifikatsiya and Kirgizgazifikatsiya associations, the Soyuztsentrgaz trust, the Soyuzgazenergoremont association, and the Soyuzgazenergoremmontazh and Soyuzgazsistemavtomatika trusts.

It was necessary for the Gruztransgaz association to solve the complex transport problem. Heavy, oversized loads for the future compressor stations were brought over the high-altitude pass via the sharp curves of the Voyenno-Gruzinskaya road.

A significant part of the work on the compressor stations was done at the Soyugazifikatsii Industrial Enterprises. As a result of finding internal reserves, the organization of the work in second and third shifts, the collectives of the Tulamashgaz, Shatskmashgaz plants, the Omsk, Novosibirsk and the Kurgan workshops of the Sibgazifikatsiya association prepared tens of block boxes, technological blocks, hundreds of connecting parts, more than 300 tons of metal structural elements and pipe assemblies in excess of the plan in the shortest possible time.

The operative execution of the entire set of operations required adjustment of the monitoring and control system. Specialized groups were created among the leading specialists of the association, the duties of which included, in addition to the performance of the basic functions, the direction and practical execution of defined operations connected both with the construction and the startup of the compressor stations. During the construction period the following groups functioned: equipment supply, equipment transportation, personnel training, support of the builders with living quarters and food, technical inspection.

These groups independently solved the operative problems, and they introduced the prospective ones at the central headquarters for the construction of compressor stations headed by deputy director of the association I. P. Zazashvili.

As a result of all of the efforts of the participants and organizers of construction, the expansion of the Ordzhonikidze-Tbilisi gas lin was completed on time. The practice of building the Chmi and the Kveshet compressor stations and also the creation of an entire series of other branch projects demonstrated that an independent construction industry had grown out of the gas industry. It is unquestionably the case that the organizations of the ministry will be capable of solving even more complex problems.

The Board of Editors of the Journal expresses its appreciation to P. M. Muzhilivskiy (the Ministry of the Gas Industry), M. S. Kalinin (the Orgenergogaz Construction Administration), I. I. Radchik and V. M. Kondrachuk (Soyuzgazifikatsiya Production Association), K. M. Nikolayshvili (Gruztransgas Production Association) for the assistance given them in organizing the material for this report on the shock construction site of the branch.

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CSO: 1822/59

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NADYM INFRASTRUCTURE CONSTRUCTION LAGS BEHIND GAS FIELD DEVELOPMENT

Moscow IZVESTIYA in Russian 29 Mar 80 p 2

[Article by V. Filatov, chairman of the ispolkom of the Nadym city soviet of people's deputies: "Houses Must Rise Quickly"]

[Text] "On to Nadym!"--with such a slogan the envoys of the komsomol team imeni 25th anniversary of the virgin soil stepped onto our northern land. The young people came from different republics and oblasts in order to build up the local severe kray. And probably all of them did not know that in the beginning of the 1970's similar words sounded here: "On to the first gas field!" This was the slogan of all those who began to develop Medvezh'ye.

Passing down the streets of Nadym past the multistory residential buildings, the wide-screen movie theater "Pobeda," past the schools and stores it is difficult to believe today that only 10 years ago the taiga was here.

The city is growing rapidly. It is only 8 years old and there are already tens of thousands of residents of which one-third are children. This is not surprising: the average age of the inhabitants is 27 and there are many young families. Two schools have been raised of 1,176 places each, new kindergartens and nurseries, and a cleaner's, laundry, and modern sanitation-type bath (without a hint of irony it is called the "Nadym Sand Dunes"). are in operation. The network of stores and cafeterias has increased. With the introduction of a central boiler house and treatment works questions of the stable supply of the residents with communal services have been solved.

The lawns are turning green on the streets of Nadym. This means a lot for us: for we had to bring in fertile soil and literally sow each blade. The young trees are taking root and the first flower beds with flowers have appeared. And then somebody feared that the living flowers, a great luxury for the north would disappear and the flower beds would be empty in one night. But once again the people of Nadym proved their love for their city and during the entire summer not a single flower was picked or dug up.

The Nadym rayon is lucky. Three of the largest fields, Medvezh'ye, Urengoy and Yamburg have concentrated their supplies of underground gas in 110,000 square kilometers on its territory. Medvezh'ye is already operating at full power, the Urengoy today gives the country 60 billion cubic meters of blue fuel, and with time will start to extract 185 billion per year. At Yamburg the first landing party is being prepared by the collective of the famous trust "Nadymgazpromstroy"--the same that constructed all 9 fields at Medvezh'ye in a short time.

The people of the north know how to work. In the 4 years of the 10th Five-Year Plan capital investments in Nadym were increased 1.5-fold, and the volume of industrial production tripled. During this period the country alone received 6 billion cubic meters of gas above schedule.

The year 1978 became memorable. Due to the early putting of the Medvezh'ye field onto the rated output the field workers, builders, installers, party, soviet, trade union and Komsomol workers, all the participants in this great business were warmly congratulated by Comrade L. I. Brezhnev. That fact is also remarkable that for the attainment of the highest indices in labor in 1977 and 1978 the city of Nadym was awarded the challenge Red Banner of the RSFSR Council of Ministers and the AUCCTU, and for the results of work in 1976 and 1979--the Red Banner of the CPSU Central Committee, USSR Council of Ministers, AUCCTU and Komsomol Central Committee. The collectives of a number of enterprises were awarded high prizes, including the largest production association in the branch "Nadymgazprom."

The rapid development of the economy naturally affects the living standard of the workers. During the current five-year plan the real incomes of the population were increased 1.5-fold, and the volume of general services--3-fold. Well-organized apartments were given to 3,500 families. The in-house base of the construction industry is developing. The first phase of the large-panel house construction plant was put into operation with output of 35,000 square meters of residences per year. In Nadym there are already over a dozen buildings made of "our own" panels: we are acquiring independence.

It is asked: is there reason for fears and distress? Alas, there is, and more than one... It is early to be reassured with what has been attained. There still exists a disproportion between the industrial and civil construction, the gap between the introduction of residences and social, cultural and general facilities is great. The number of gas extractors, transportation workers and installers in the city is constantly rising; it is necessary for these people to be firmly secured in a new place, to feel at home, as they say, seriously and for a long time, and this requires the creation for them of conditions no worse, and perhaps, even better than in other rayons of the country. This means, first of all, providing them with well-organized apartments, giving them places in the day nurseries and kindergartens, and providing the children with the possibility of normal education. This is not always a success. A vicious circle develops: the people who are so needed for building up the north at times leave due to its lack of building-up.

The industry of Nadym is developing ahead of the plans. The steady attention of the workers, specialists and leaders of all ranks is concentrated on construction of fields and extraction of gas, on laying of pipelines and erecting compressor stations. This is good of course. But the setting up of the complicated municipal organism is far from a secondary task. Many economists have recently started to understand more fully and deeply the interrelationship between the growth of labor productivity and its quality and the cultural-general conditions under which the people live. However far from everything is being done to improve these conditions.

What are the reasons for this? The impetuous rate of the polar region construction has an effect, and this means, inevitable "costs of growth," complexities in delivering goods, shortage of qualified personnel, harsh climate conditions... And the most important--the incorrect views of certain economic leaders on the very principle of social and economic development of the population points in the oil and gas northern region.

The problems linked to this are often discussed at the sessions of the city soviet, meetings of the ispolkom and permanent commissions. We listen to the reports of the economists, and succeed in getting them to consider the construction of residences, schools, children's institutions, and enterprises of trade and general nutrition just as important as the erection of industrial facilities. The soviet focuses special attention on the instructions of the electorate. During the period from elections to elections of the 54 instructions 51 were fulfilled: a book store, pharmacy, children's dairy kitchen and library with reading hall were opened, bus traffic was organized and about 100,000 square meters of residences were built.

Certain rules for the development of new cities exist. Completion of the first phase of the population point must correspond to the putting into operation of the appropriate facilities of production that gave life to the city. But the fields of Medvezh'ye have already been operating at full force for 2 years, and the Nadym complex is not yet ready. What is the explanation?

It is difficult to given an unambiguous answer, but this is indisputable: the impetus for developing the underground storehouses required the accelerated development of plans for the building up of the first microregions, and drawings of residences, social, cultural and general facilities, and engineering networks were urgently needed. However, the general planner of Nadym, the institute LenZNIIEP [Leningrad Zonal Scientific Research and Planning Institute of Model and Experimental Planning of Residential and Public Buildings] could not rapidly prepare them.

The people of the north know how carefully this institute thought out the placement of buildings. The model of the city was tested many times in an aerodynamic tunnel to create a special microclimate in the apartments. A lot was successful: Nadym reliably protected the schools and kindergartens from the icy breath of the north. However, the shortage of technical documents is delaying the introduction of the planned residences. As yet we have not been able to begin construction of a number of facilities forming the appearance of the city.

In Nadym there is essentially still no center. And we can see a spacious main square, such public buildings as the House of Soviets, Palace of Culture, hotels, House of Pioneers, and tall residential buildings with built-in facilities of trade and daily life... One should admit the omissions of the municipal department of architecture. Its workers at times put up with low quality of construction and close their eyes to the unattractive external appearance of the structures. This can be partially explained by the weak production base, shortage of painting and finishing materials, and the absence of drawings of nine-story buildings.

There is yet another important question: the wooden (block) houses. The idea of the rapid creation of a compact city made only of brick and reinforced concrete is attractive in itself, however it inevitably contradicts practice. In the counted years it is exceptionally complicated to organize in the taiga and tundra an army of builders for the construction of oil and gas facilities and at the same time create a stone city for several tens of thousands of residents. And is there even a need for this? What is poor about the prefabricated wooden two-story houses with all the conveniences that completely meet the conditions of the polar region? It is no accident that the recent decree of the party and government indicated the need to develop panel wooden house construction. And at first excellent microregions can be rapidly formed from such houses.

The abandonment of the "pieces of wood" resulted in the fact that in the general plan we see an excellently planned city, and in fact--waiting for principal apartments many families are dispersed in vans, "ravines," and little houses of the most unthinkable shapes. Such is an example: in order to free the place for the hospital complex we were forced to move about 200 "self-built structures," and for some of them this was not the first time. It seems to us that LenZNIIEP, still occupying the position of the outside observer must take into consideration the urgent requirements of life.

A great positive effect could be yielded by individual construction. But under the conditions of strained funds for items made of wood it is difficult to a considerable measure. It would be expedient to set up manufacture of model sets of houses for individual builders in one of the regions of the Yamalo-Nenetskiy district or somewhere near the Ministry of the Timber and Wood Processing Industry.

The ispolkom of the city soviet considers the creation of an in-house base of the construction industry a matter of primary importance. Today the output of the Nadym DSK [house-building kombinat] will rise to 50,000 square meters of residences per year, then the trusts "Severgazstroy" and "Nadymgazzhilstroy" will double it. This requires pulling up of the "rear":

expansion of the shop of claydite gravel, concrete mixing assembly, perfection in the transportation system for delivering cement and metal. The finishing of the outer panels should also be improved so that the buildings look brighter and more cheerful. Here we await the help of the association "Sibshilstroy."

It is impossible to keep quiet about the question of building a brick plant in Nadym. The Tyumen' institute "Promstroyproyekt" long ago compiled the documents for an enterprise with output of 12 million bricks per year, and not far from Nadym supplies of high-quality clay were found. However, the ministries engaged in the development of Yamal have not included this facility in their plans. They believe that it is easier to bring in bricks from Novosibirsk, Omsk or Tyumen'. It would not be interfering to analyze how much it will cost the state and what kind of material we will receive after several trips...

It is also difficult to explain the following: about 5 years ago we were delivered 1.5-fold more bricks by navigation than now. Precisely due to a shortage of bricks the erection of the sports complex, trade center, hospital and several dormitories has been "frozen."

We bring in about a million tons of the most diverse goods over the open water. We await impatiently the completion of construction of the railroad Surgut-Urengoy. This will greatly simplify the delivery.

...Despite the difficulties, our northern city continues to grow and improve. The word "nadym" is translated into Russian as "joy," "happiness." This is symbolic. In the name of happiness of the Soviet people the underground riches of Yamal are being developed. And those who are engaged in this great state matter find joy in their work.

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CSO: 1822

PRODUCT PIPELINE TO TOBOL'SK ANCHORED BY HARPOON CANNON

Moscow PRAVDA in Russian 8 Apr 80 p 1

[Article by B. L'vov, correspondent of the Ministry of Construction of Petroleum and Gas Industry Enterprises Press Center: "In a Single Stream"]

> [Text] More kilometers of the Yuzhnyy Balyk-Tobol'sk product pipeline. Oilfield flares will be extinguished. "Harpooners" are helping the trunk pipeline builders.

The first 50 km of the Yuzhnyy Balyk-Tobol'sk product pipeline has been tested under pressure for the first time. This is still only an eighth of the arterial that will be called upon to breathe life into Tobol'sk Combine installations and units. For this reason, work must be speeded up here in every possible way.

The first segment of the arterial is an element of a ramified grid of underground arteries, already constructed, that is helping to make use of casing-head gas of the West Surgut, South Surgut, Solkta, Mykhpay and certain other fields. It is now being used completely. But still, not all the flares at the Samotlor and Fedorovskoye deposits have been extinguished. This will occur when the gas treatment plants at Surgut and Belozernyy are put into operation. The concluding startup and setting up operations there are at their climax. The product obtained there from the casing-head gas will be poured together into a single stream with that already being obtained at the Yuzhnyy Balyk plant, and from there it will go over the new line to the Tobol'sk Petrochemical Combine for further processing.

To speed up construction of the main underground route to this combine and to carry out the socialist commitments adopted in honor of the 110th anniversary of V. I. Lenin's birth--these are the strivings of the collectives of the trusts that are laying the 400-km line. Already 370 km of pipeline have been welded into a continuous strand, and more than 330 km have been dressed in a reliable anticorrosion jacket and laid in the trench.

The day's pace has reached 3 km for welding, and up to 5 km for insulating and laying work.

"We are accustomed to the successes of men such as installer N. Novgorodtsev, excavator operator I. Dermanskiy and welder V. Kolesnikov," says Chief Engineer of the Installing Administration M. Lukin. "But it would not be possible to take advantage of the labor results of advanced workers on this line without the help of the harpooners."

...After the firing with a bluish puff of smoke, the towing vehicle, rumbling with its tracks, finally moves heavily over the marsh's hummocks, pulling an unusual cannon. On the side, on racks, strange multimeter sharp-nosed "projectiles" can be seen. "This is the ordinary harpoon gun for hunting whales"; the motion pictures that I had seen were revived in my memory.

Actually, of course, there are no whales here, but there are harpoon guns. And the success of the excavator operators, the installers and the insulators depends upon the harpooners' results. The "cannoneers," as they call the harpoon-gun operators here, fasten the pipeline that has been welded onto the strand with special anchoring projectiles shot from their guns.

The anchor fastening is a progressive method for raising the reliability of laying pipelines, guaranteed insurance against their rising to the surface during the crossing of the swamp and marsh. The method was worked out by the joint efforts of production workers and scientists. Such a fastening is used to replace the heavy concrete weights that usually hold the pipeline at the bottom of the marsh. But many thousands of weights had to be made, then delivered to the taiga's backwoods, and finally hung on the pipe, which could not be done without the help of helicopters. All this took a long time and was expensive and extremely labor-intensive, and the main thing--it was not very reliable.

Replacement of the weights by paired anchor projectiles shot from whaling cannons has speeded up the business. Moreover, the fastening, it can be said, is permanent. Extracting the anchor projectiles from the thick marsh is practically impossible. According to the estimates of Glavsibtruboprovodstroy [Main Administration for Laying Pipelines in Siberia] specialists, savings from using the anchors run up to 80,000 rubles per kilometer of 1,420-mm diameter pipe.

Thus this engineering idea speeds up laying of the underground river of casing-head gas.

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CSO: 1822

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FLEET IN THE SERVICE OF GAS AND OIL EXTRACTION

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 p 9

[Article by A. Trutnev, Press Center of the Ministry of the Gas Industry]

[Text] In December 1948, one of the groups of Neftyanyy Kamni installed the first drilling rig. On the small Transportnik bridge-erection boat the sailors delivered the builders and the drilling rig operators. With the landing of this group, the planned assault on the oil and gas pools of the Caspian began. The labor front which developed at Azerbaydzhan was at that time commanded by the chief of the Aznefterazvedka association S. A. Orudzhev -- now the minister of the gas industry.

The problems of creating the specialized fleet capable of providing for the construction and servicing of the marine oil and gas extraction sites were solved in the shortest possible time.

In November 1949 the administration of floating facilities which subsequently became the Kaspnefteflot and then the Kaspneftegazflot administration, was created.

At that time the fleet could not provide for the solution of the complex problems arising during assimilation of the marine oil and gas bearing areas. There was an acute necessity for specialized vessels.

By the proposal of S. A. Orudzhev in December 1949, requipment of the "Izmail" bulk oil lighter into the "Azerbaydzhan" crane-installation ship was completed. Its crane could lift loads of up to 60 tons. The problem of building the large-modular foundations for the marine drilling rigs at depths of down to 20 meters in the sea was solved in this way.

In April 1950 an enormous crane ship, the "Useyn Rakhmanov," was put into operation. It was built on the basis of the dry-cargo river ship and was equipped with two 40 ton cranes. In the next five years the fleet of ships of the "Kaspnefteflota" adminstration was filled out with 10 more floating cranes.

At the same time the design and construction of small crane ships were begun; their steel booms could lift loads of up to 20 tons. Thirty such vessels ventured out on the Caspian Sea between 1952 and 1965. In May 1954, the transport-installation catamaran constructed on the basis of two nonselfpropelled bulk oil lighters with a capacity of 3700 tons, was launched, and it is in industrial operation today. In 1967 an analogous ship, the "26 Baku commissars," was built. The foundations for marine drilling rigs at depths of down to 40 meters were constructed using these catamarans.

However, it was impossible to develop the discovered oil and gas-bearing areas at even greater depth using the available fleet. Therefore, in October 1965, the powerful "Kerogly" crane ship was put into operation. This giant ship with a 250 ton crane helped to master the Caspian at depths of down to 84 meters.

At the present time the specialized fleet of the "Kaspneftegazflot" Administration numbers more than 400 ships. There is a unique pipe-laying ship, the "Suleyman Vezirov." A marine fire-fighting detail has been created made up of 11 ships and 3 boats. In the near future the fleet will be filled out with the "Azerbaydzhan" ship with a 2500 ton crane.

The mastery of the deep-sea deposits requires the creation and introduction of reliable technological floating facilities with high technical-operating indexes which provide for the large-modular installation of hydroengineering structures and a high degree of industrialization of operations.

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CSO: 1822/59

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UDC 622.245.44

USE OF TUBING PACKERS ON DIRECTIONAL WELLS IN SAMOTLORSKOYE DEPOSIT

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 3, Mar 80 pp 64-67

[Article by Z. Sh. Akhmadishin (Surgut Petroleum and Gas Association), A. A. Gayvoronskiy, A. A. Tsybin, V. I. Vanifat'yev (VNIIBT--not further identified], M. N. Safiullin and B. I. Krasnov (Main Administration for Petroleum and Gas for the Tyumen Region]

[Text] The use of hydraulic tubing packers is an effective way to improve the quality of the separation of formations during reinforcement of directional wells in complicated conditions.

In the period 1974-1978, 220 PFG [not further identified] tubing packers of the VNIIBT design were introduced in the reinforcement of 135 directional wells. In 1976 jointly with the PFG, more improved PGP [not further identified] tubing packers were introduced at the Samotlorskoye deposit. The packers for 146- and 168-mm casings were manufactured in series by Neftemashremont [Oil Drilling Machine Repair Plant] at Kalush. Special rubberized fabric packing elements of the flexible tube type, developed by the Scientific Research Institute of the Rubber Industry and made by the Kazan' Industrial Rubber Products Plant, were used in them.

Analysis of the geophysical investigations by means of SGDT [not further identified] and a coupling factor permitted refining the places of installation of 183 packers in 119 wells. In the remaining wells, due to the absence of geophysical data, the depth to which the packers should be lowered has not been established.

During field introduction packers were tested for the isolation of various producing formations. From one to four packers have been installed on an operating tubing, and this permitted creating one or several hermetic connections in the hold tubing space at the necessary depth. Of 183 packers, 75 (41.0 percent) were used to separate the oil-bearing and the oil- and gas-bearing formations B_8, B_{10}, A_{4-5}, A_{2-3} and A_1 from the water-bearing horizons; 74 packers (40.4 percent) to prevent tubing overflows of gas from oil- and gas-bearing formations of group A into the water-bearing sandstones of the Senomanskoye deposits lying higher and the oil-bearing horizons lying lower.

Analysis of the data on the positions of packers in the drillhole showed that the remaining 34 packers (18.6 percent) were not installed where they were needed. Thus, in wells 4578, 15048, 7006 and 7169 the packers were installed in the perforation zone, in wells 2676, 2863 and 7130 in intervals of occurrence of water-bearing horizons, and also in other intervals where the advisability of their application gives rise to doubts.

Taking into account the large number of producing wells at the Samotlorskoye deposit, and also the absence of complete and systematized data on the flooding and tubing overflow of gas due to the poor quality of separation of formations during reinforcement, we analyzed the estimation of the quality of isolation of some producting formations in wells equipped and not equipped with packers. Field data on 600 wells of the deposit were used for the analysis [2].

In that case the wells with impermeable connectors of comparable thickness between oil-bearing and water-bearing horizons were considered. To obtain more reliable data in analysis of the quality of isolation of oil-bearing formation we examined wells not equipped with tubing packers and organized or put in operation in 1977 or the first half of 1978.

Presented in Table 1 are data on wells drilled on oil-bearing formation B_3, on 50 percent of which the connector between the oil- and water-bearing horizons amounts to 2.6 m on the average, and on the rest 8.3 m on the average. All the walls under consideration were flooded due to poor quality of the reinforcement in the period of organization or in the first 4 months of operation. The flooded wells were about 5 percent of those examined.

The presence of tubing water overflows in those wells was confirmed by the geophysical investigations. The flooding of wells reduces by a factor of 2 or 3 the average annual oil flow and in the final account requires that repair isolation work be done.

Presented in Table 2 are data on wells equipped with packers to prevent tubing water overflows. The thickness of the impermeable connectors on 50 percent of the wells is 0.8 m on the average and on the rest is 8.2 m on the average. In contrast with wells drilled on oil-bearing formation B_3 and not equipped with tubing packers, the wells referred to in Table 2 have been in operation for from several months to 4 years. During operation, in not one of the wells equipped with packers did water overflows occur across the tubing space.

Wells not included in Table 2, where the packers were used to isolate oil-bearing formations from nearby water-bearing formations, were not used in making the analysis for the following reasons.

The thickness of the connectors between the oil- and water-bearing zones in some wells was greater than that taken for comparison of flooded wells without packers. A portion of the wells, after a certain period of operation (about 2 years) in the course of which in not one of them were tubing water overflows noted, was transferred to pressurized conditions.

Table 1

Well No	Dates well put in operation	Dates of flooding	Interval, m of oil-bearing part of formation	Interval, m of perforation, m	Interval, m of water-bearing zones or bottom waters
5504*	Oct 1977	Jan 1978	2156.6-2177.2	2164.6-2177.5	2136.0-2120.0
3521*	Sep 1978	in organization	2200.0-2212.1	2200.0-2208.0	2217.0-2246.0
11012	May 1978	May 1978	2236.4-2267.2	2236.5-2243.5	2267.2-2284.0
10231*	Sep 1977	Dec 1977	2098.8-2143.4	2134.0-2142.0	2155.0-2164.0
10221*	100% flooding in organization		2227.6-2246.0	2232.0-2240.0	2224.8-2215.0
10357*	Sep 1977	Nov 1977	2140.0-2187.2	2172.0-2186.5	2194.0-2204.0
10255*	100% flooding in organization		2072.2-2119.6	2101.5-2111.0	2130.0-2141.0
4563	Oct 1977	Nov 1977	2155.0-2204.0	2155.6-2183.5	2213.0-2225.0
10262**	100% flooding in organization		2176.8-2222.0	2212.0-2221.0	2238.0-2244.0
					2161.0-2132.0
4745**	100% flooding in organization		2324.8-2339.0	2324.0-2339.0	2340.0-2376.0
10294	May 1977	Sep 1977	2144.5-2185.0	2144.5-2176.0	2200.8-2212.0
4574	Sep 1977	Jan 1978	2131.2-2158.2	2149.0-2157.0	2158.2-2176.0

*Repair isolation work was done in the wells after they were flooded during organization or during operation.

**Wells stood in expectation of repair isolation work due to 100% flooding.

Table 2

Well No	Date well put in operation	Interval, m establishment of packer	Interval, m of oil-bearing part of formation	Interval, m of perforation, m	Interval, m of water-bearing zones or bottom waters
3050	Oct 1974	1808.2-1812.2	1775.6-1815.0	1775.6-1791.0	1815.0-1828.8
4627	Nov 1974	2049.0-2053.0	2063.2-2110.0	2070.0-2110.0	2043.0-2022.0
4913	Feb 1974	2136.0-2140.0	2142.8-2192.5	2146.0-2192.5	2128.0-2100.0
4876	Jun 1974	2161.5-2165.5	2165.2-2219.5	2168.5-2218.0	2149.5-2136.0
3288	Jun 1975	1784.0-1788.0	1751.6-1796.6	1765.5-1780.0	1796.6-1802.8
3289	Jun 1975	1819.2-1823.2	1786.0-1825.6	1788.0-1811.0	1825.6-1843.8
3374	Feb 1975	1878.2-1882.2	1843.4-1886.8	1846.0-1862.0	1886.8-1903.2

Table 2 (Continued)

		Interval, m			
		establishment of packer	of oil-bearing part of formation	of perforation, m,	of water-bearing zones or bottom waters
3554	Jun 1976	1783.2-1787.2	1762.8-1788.0	1763.0-1769.0	1788.0-1836.0
7130	Jul 1976	1800.2-1804.2	1743.0-1794.0	1776.0-1794.0	1804.0-1864.0
2941	Nov 1976	1843.0-1847.0	1804.4-1846.4	1809.0-1829.0	1846.4-1863.2
15070	Jun 1976	1819.6-1823.6	1792.5-1802.5	1792.5-1802.5	1825.0-1884.0
5316	Aug 1976	2066.0-2070.0	2084.0-2129.0	2087.0-2125.0	2063.0-2041.0
5336	Sep 1976	2087.6-2091.6	2097.6-2148.8	2103.0-2140.2	2085.0-2093.0
3725*	Oct 1977	1736.3-1740.3	1686.0-1727.0	1694.0-1715.0	1746.0-1776.0
7172	May 1977	1956.2-1960.2	1898.0-1958.0	1939.0-1953.0	1964.0-1984.0
7424	Apr 1977	1822.0-1826.0	1782.0-1819.0	1807.6-1819.0	1838.8-1909.0
2850	Feb 1977	1839.5-1843.5	1794.0-1843.8	1794.0-1833.0	1843.8-1856.2
6072*	Aug 1977	2216.4-2220.4	2208.4-2218.4	2208.0-2215.4	2218.4-2247.2
4633	Oct 1977	2041.0-2045.0	2058.0-2098.0	2072.0-2098.0	2036.0-2008.0
5476	Nov 1977	2054.4-2062.4	2062.6-2109.0	2079.2-2092.2	2048.0-2036.0
13102	Jun 1977	1739.4-1743.4	1720.4-1740.0	1725.0-1734.0	1740.0-1751.6
2771	Dec 1977	1921.2-1925.2	1868.4-1913.4	1895.0-1913.0	1928.0-1992.0
5520	Jan 1978	2135.2-2139.2	2121.0-2139.4	2121.0-2128.0	2139.4-2168.0
14031	Aug 1978	1797.0-1801.0	1738.8-1768.0 1776.8-1797.0	1739.0-1768.0	1797.0-1828.0
14352*	Nov 1978	1790.0-1794.0	1737.5-1790.8	1742.0-1788.0	1800.6-1837.4
2919*	Jun 1978	1932.4-1936.4 1994.8-1998.4	1934.0-1984.0	1938.0-1943.0	1997.0-2041.2
7450	Sep 1978	1922.8-1926.8	1884.0-1922.0	1908.0-1922.0	1934.6-1938.4
7496	Nov 1978	1805.0-1809.0	1762.0-1805.8	1796.0-1800.5	1808.4-1849.8
2628	Sep 1978	1820.0-1824.0	1790.0-1817.6	1790.5-1811.0	1817.6-1852.0
14340	Sep 1978	1781.0-1789.0	1734.0-1807.2	1744.6-1773.0	1807.2-1838.6
14032	Sep 1978	1762.0-1766.0	1717.2-1773.5	1728.0-1751.0	1778.4-1796.0
11003	Sep 1978	2103.5-2107.5	2117.4-2153.2	2120.0-2134.5	2102.0-2092.0
3622	Aug 1978	1737.0-1741.0	1675.2-1740.4	1687.0-1697.5	1740.4-1756.0

*Wells in which RGP were used.

As a result of the analysis, recommendations were issued on the advisability of installing tubing packers, depending on the specific geological and technological conditions.

The application of tubing packers improved the quality of separation of producing formations from water-bearing zones, which prevented the formation of tubing water overflows during organization and operation.

Tubing water overflows are noted at the Samotlorskoye deposit also in drive wells. Due to the poor separation of formations in those wells the water pumped into the oil-bearing formation B_3 travels along the tubing space into the above-lying water-bearing formation B_6. In some drive wells the water pumped into the oil-bearing formation B_8^0 travels along the tubing spece into the lower-lying operated formation B_{1+2}^0 or the reverse. Tubing water overflows are noted in drive wells 3676, 5077, 5334, 5601, 6696, 10834, 10942, 3063, 4910 and 10359. Therefore the tubing packers of the VNIIBT design also must be set on the casings in drive wells, isolating from above and below the formation where the water pumping is planned.

At the Samotlorskoye deposit in wells 2157, 4906, 10949, 6681 and 7209, drilled earlier and not equipped with tubing packers, tubing gas overflows were observed. Of 74 packers intended for the prevention of tubing gas overflows, 44 were installed to prevent gas migration along the tubing space upward into the water-bearing sandstones of the Senomanskoye deposits (wells 3724, 7045, 1100 bis, 7222 and 16419). Analysis of the data on the wells showed an absence of tubing gas overflows.

Also noted during operation of the well were cases of gas leakage into the zone of perforation of oil and gas formations of group A (well 3407). To prevent gas overflows between the oil-saturated and gas-saturated zones, 30 packers were installed (wells 3724, 2919, 3622, 4104, 2873 and 7118). Analysis of field data on those wells has shown that when in operation packers assure fairly reliable isolation of the gas-bearing part from the oil-bearing part and there was no gas leakage into the perforation zone.

To increase the effectiveness of the application of tubing packers during reinforcement of directional wells it is necessary: for the Administration for Drilling geological service, by agreement with the Administration of Oil and Gas Production (the customer) to determine the intervals of their installation in each well according to the results of electrometric investigations of the productive part of the drillhole before the operating tubing is lowered, to raise the requirements for precision of the installation of packers in the prescribed intervals when the casings are lowered into the well, and to monitor the quality of packer installation with SGDT and AKTs [not further identified] instruments and on the basis of the results of the organization and the initial period of operation, and the precision of installation by the coupling locator.

On the basis of the analytical data the following recommendations have been developed on the designation and selection of the intervals of tubing packers in the reinforcement of directional wells at the Samotlorskoye deposit.

In producing wells, to isolate oil-bearing formations B_8, A_{2-3} and B_{10} from bottom waters the filler element of the packer should be installed in the presence of an impermeable (low-permeable) connector with a thickness of 3 m or more opposite it between the oil- and water-bearing parts of the formation; at a thickness of the connector of less than 3 m or in the lower oil-bearing part of the formations under the perforation zone, and the other in the water-oil contact zone. To isolate the oil-bearing formation B_8 from the higher-lying formation B_6 the packer should be installed below the latter; if formation B_8 consists of the three formations B_8^0, B_8^{1-2} and B_8^3, in the intervals of the connectors between them.

In drive wells, to isolate the perforation zone from the higher and lower formations the filling elements of the packers should be installed above and below the perforation zone opposite the low-permeability connectors.

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CSO: 1822

FUELS

UDC 622.276:652

DEVELOPMENT OF THE PROCESS OF STEAM OIL DRIVE AT THE KENKIYAK DEPOSIT

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 3, Mar 80 pp 40-44

[Article by B. S. Sagingaliyev (Embaneft'--not further identified), N. L. Rakovskiy and S. V. Kapanev (VNII--All-Union Scientific Research Institute)]

[Text] Since 1972, on a section of the Kenkiyak deposit of the Kazakh SSR, experimental steam drive has been used to increase oil production in working a formation of high-viscosity oil [1]. The work has been done in accordance with a technological process developed by the VNII jointly with the Central Scientific Research Laboratory of Embaneft' in 1968. The process of steam driving has been expanded steadily with the input of experimental elements into the development. In 1972 three wells were put under steam driving, one in 1973 and two more in 1977.

In 1977, on the first of the experimental units, unheated water began to be driven to move the steam edge, and in 1978 steam began to be pumped into a producing well. Thus in 1978 six steam-driven and one water-driven wells were in operation on the experimental section (Fig 1).

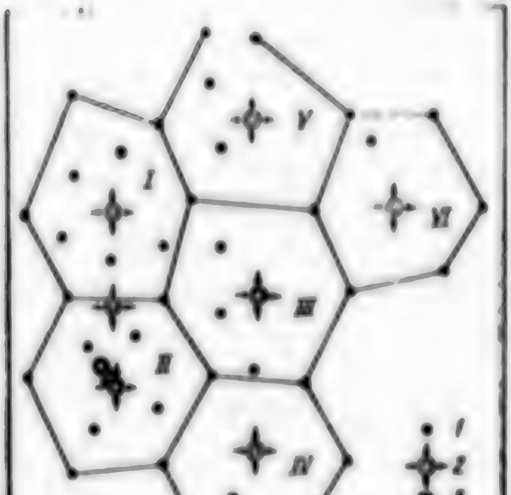

Fig 1. Schematic diagram of the arrangement of wells on the experimental section.

I - VI -- the area units respectively;

1,2,3 -- producing, drive and control wells

In the four area units the wells are arranged on a reversed 7-point system at a distance of 200 m from the drive well. In two units the producing wells are arranged around the drive well in two rows, the first row is at a distance of 100 m and the second at a distance of 200 m from the drive well.

At the end of 1978, as the number of available steam generators increased, steam began to be pumped into three pressurised wells situated west of the test section on a linear system. At the same time the method of steam drive in combination with flooding of the Kenkiyak deposit as a whole began to be introduced industrially. Let us examine the development of this process in greater detail.

The operation of test section wells. Within the limits of six test section units the number of producing wells in operation gradually increased from 6 in 1968 to 38-39 in 1977-1978. The data on their operation from the start of steam drive (1968-1972) and in its period (1973-1978) are presented in Table 1.

According to the actual change of the flow in the first years of operation an empirical dependence of an exponential type was obtained [1] which permitted estimating the calculated reduction of oil flow in proportion to exhaustion of the formation. Comparison of the actual and calculated oil flows shows the steam drive to have been stabilised and the flows to have been increased in 1974, 1975 and 1977.

In 1972, when the steam drive was begun in units I, II and III, the oil yield for the six-unit section was 100 tons per day and the average oil flow per working well was 6.3 tons per day. By the end of 1979, as the process was expanded, oil production almost doubled (191 tons/day) but the oil flow remained practically unchanged (6.1 tons/day/well). In the absence of steam pumping and during development of dissolved gas under natural conditions the flows would decrease, calculations show, to 2.5 tons per day (incidentally, the actual flows of wells on the sections not subject to the effect of steam heat are not more than 2-2.5 tons per day).

The highest oil flows on the experimental section reached 14-22 tons per day in 1978 and could have been still higher if there had not been a negative influence of sand. Some wells stand for a long time awaiting maintenance (cleaning of the sand plugs, replacement of pumps, etc). In 1978 sand was observed in the production of 21 wells and in only four of them was the sand content over 1 percent. The maximum sand content obtained in the analyses of seamples from producing wells is 2.6-3 percent.

Washing the sand plugs and the dropping filters from the cushioning layer of sheel rock remain the main measures in combatting that phenomenon. However, an effective solution of the given problem has not yet been found. As a result of that the mean well operating coefficient in 1966-1978 was 0.74 for the entire section and the entire period and also was 0.74 during

Table 1

Year	Mean number		Mean daily flow per well, tons/day		Mean flooding, %
	of producing wells in operation	of working days per producing well	actual	calculated for depletion conditions	
1968	6	304	13.0	12.8	-
1969	11	277	10.6	10.9	0.4
1970	21	266	10.1	9.3	1.5
1971	24	215	8.1	7.9	4.7
1972	21	205	6.3	6.7	7.9
1973	24	237	6.2	5.7	17.1
1974	28	248	7.2	4.8	18.2
1975	37	277	7.4	4.1	28.2
1976	39	282	6.8	3.5	34.3
1977	39	285	7.1	3.0	38.2
1978	38	298	6.1	2.5	38.9

the period of steam drive (1973-1978) and 0.79 in the last 3 years. The presented data show that the low operating coefficient results from the properties of the collector and the application of the heat effect does not worsen but improves that indicator.

The development of the experimental section is accompanied by increased flooding of the wells. Before steam drive the flooding increased slowly and was 7.9 percent in 1972, and the perimeter region was the water source. With the start of steam pumping the flooding increased sharply from 17 percent in 1973 to 38.9 percent in 1978.

Investigations of the produced liquid and chemical analysis in particular of its salt content, hardness and alkalinity show that the source of flooding is the steam condensate pressurized in wells of the experimental section. Since the oil of the Kenkiyak deposit is highly viscous (about 180 cP) the indicated flooding should not be considered extremely high.

The working indices of the drive wells of the experimental section are presented in Table 2. Saturated steam with a temperature of 230-240°C was pressurized into the wells, that is, steam with parameters close to the designed parameters. The dryness of the steam, measured at the steam generator outlet, was 0.8, somewhat below the designed (see Table 2). The dryness of the steam at the heads and bottom holes of steam drive wells respectively diminished somewhat.

The main shortcoming was low flow rates of the steam drive (65-83 instead of 100-120 tons/day as designed) due to insufficiently good functioning of the steam-generating equipment, frequent downtimes, etc. In 1979, with the participation of a large collective of adjusters of Soyuztermneft' [not

Table 2

Year	Number of operating wells		Mean daily flow per drive well, tons/day		Characteristics of pressurized steam	
	steam drive	water drive	steam	water	t, °C	dryness
1972	3	-	55	-	227	0.69
1973	4	-	65	-	208	0.72
1974	4	-	66	-	243	0.75
1975	4	-	73	-	232	0.79
1976	4	-	83	-	237	0.78
1977	5	1	68	376	250	0.78
1978	6	1	73	264	250	0.75

Table 3

Year	Quantity of pressurized 1000 tons		Oil output in steam drive units*, 1000 tons		Steam-oil factor tons/ton for oil output	
	steam	water	total	additional	total	additional
1973	85	-	25	-	2.4	-
1974	89	-	36	24	2.4	7.2
1975	106	-	59	45	2.1	4.1
1976	117	-	61	49	2.1	3.3
1977	113	36	79	55	1.9	3.0
1978	127	40	70	48	1.9	2.9

*Oil yield by units, where steam or water is pressurized, and only from the start of their pumping.

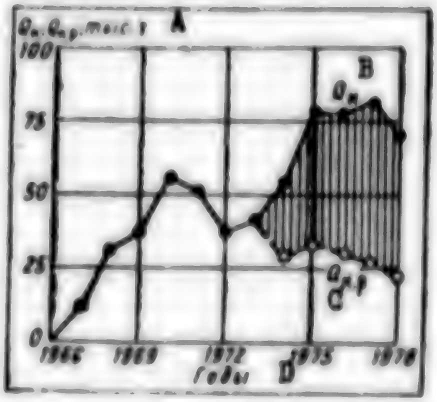

Fig 2. Dynamics of the actual Q_{oil} and calculated $Q_{oil_{calc}}$ (in depletion conditions) annual oil output for six units.

A -- Q_{oil} and $Q_{oil_{calc}}$, 1000 tons

B - Q_{oil}

C - $Q_{oil_{calc}}$

D - Years

Table 4

Area unit	Quantity of pumped agents, share of pore volume	Pressurised and removed volumes ratio	Oil yield	
			at start of process	by 1979
I	0.16	0.78	0.09	0.30
II	0.16	1.77	0.02	0.10
III	0.12	1.60	0.06	0.13
IV	0.14	3.30	0.02	0.08
Entire section	0.11	1.31	0.06	0.15

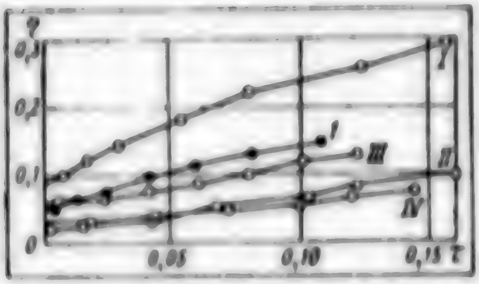

Fig 3. Variation of oil output by units and the experimental section as a whole (t is the quantity of pumped working agents in shares of the pore volume).
I, II, III and IV are the area units; 1 is the section as a whole

further identified], five of seven installed steam generators were successfully started and the flow rate of the pressurized steam was increased.

The flow rates of unheated water driven beyond the steam margin in unit I greatly surpassed the recommended rates (264-376 instead of 200-240 tons per day), which is undesirable because it can lead to premature cooling of the formation, leakages of water and reduction of the coefficient of embrasure of the formation by the effect.

The work of separate units and the section as a whole. Due to the geological and industrial differences of separate area units of the experimental section (distance from the initial oil-bearing contour, the density of the well network, the intensity of the manifestation of sand, the time of input of units into development with steam drive) their working indicators are not the same.

Units I and II, situated near the dome part of the formation, have better well flows, oil output and steam-oil factors, and Units II and IV, in the water-oil zone, worse parameters.

The best indicators were obtained for unit I, drilled on a denser grid of wells (about 1.0 ha/well): the flow for one producing well is 8-10 tons per day, and the stream-oil build-up factor is about 1 ton/ton. Unit IV has worse indicators: the oil flow is 3 tons per day and the steam-oil factor is 5-6 tons/ton. On the average for the entire experimental section the oil flow is 6-7 tons per day and the steam-oil factor is 1.9 tons/ton. Table 3 and Fig 2 present data on the dynamics of the pressurizing of active agents and the removal of liquid and oil in the experimental section.

In the 6-year period of development of the experimental section in natural conditions of depletion the average annual oil output was 37,000 tons, and during the same period the steam drive increased to 67,000 tons per year. If the reduction of flow in depletion conditions is taken into account, the removal rates during steam drive are 2.5 times those for depletion conditions.

The steam-oil factor diminished from 2.4 tons/ton at the start of the process to 1.9 tons/ton in 1977-1978. If the steam flow rate is related only to the additionally produced oil, the indicators will be higher. As the share of additionally produced oil in the total production increases the indicators converge. In 1977-1978 the steam-oil build-up factor in relation to the additionally produced oil was 2.9-3 tons/ton (see Table 3).

At the Okha deposit, where the steam heat effect is accomplished after almost complete depletion of the formation in natural conditions the steam-oil factor amounts to 2.5 tons/ton in relation to the total oil production and 3.5-4 tons/ton in relation to the additional. The advantage of the application of steam heat effect in formations of high-viscosity oil from the start of their development is evident from a comparison of those indicators.

Analysis of current indicators of development of the experimental section. In the process of steam drive the development of the experimental section is constantly monitored: the flows of producing wells and the temperature of the extracted liquid are measured; samples are taken to determine the flooding and the sand content in the produced liquid; a chemical analysis is made simultaneously of the recovered water for the soil content, hardness and alkalinity; the temperature is measured periodically with depth instruments in inspection wells.

As a result of the investigations, profiles are contructed of the temperatures along the separate lines of flow, maps of equal properties of simultaneously recovered water, etc. This permits establishing the propagation of thermal zones in the formation, the overtaking advance or lag of the front of displacement, indirectly determining the embrace of the stratum by the effect on the area and designating recommendations on the redistribution of the flow in the stratum.

The results of chemical analysis of the water and measurements of the temperature of the liquid at the head of producing wells testify that the fronts of oil displacement by cold and hot water reached the bottom holes of some wells. Thus in 1978 the salt content in water taken from many wells of the experimental section was much lower (2000-4000 mg/liter) than in the water of the remaining wells, situated outside the experimental section (6000-10,000 mg/liter). It is characteristic that in comparison with 1977 the number of wells with a lower salt content in the water rose from 10 to 21. The reduction of the salt content in the simultaneously obtained water is explained by dilution of the stratal water by the condensate of the pressurized steam. The lower the salt content in the water in the sample of well production, the further thr front of displacement of oil by water from that well advanced.

The temperature of the liquid, measured at the head of about half the producing wells, testifies that elevated temperatures (20-85°C) are observed on their bottom holes, that is, in the leading edge of the hot water front has passed through them. It is characteristic that those wells are situated nearer the drive wells than the boundary wells. The number of wells with an elevated temperature was 4 in 1977 and 19 in 1978.

Chemical analysis of samples of liquid taken from wells with elevated temperatures indicates a smaller salt content in the associated water, which corresponds to the concept of the process of steam drive; the front of displacement of oil by cold water over the stratum proceeds earlier than the hot water front.

Of great importance are calculations of the dimensionless volume of the pressurizing of working agents, the pressurizing balance and the yield, the oil yield of the stratum by individual units and the sector as a whole, the results of which are presented in Table 4. Analysis of the data shows that the pressurization volumes by units of the experimental system are distributed irregularly, mainly because of the technical possibilities of well operation, their disposition in relation to the oil-bearing contour and the degree of sand manifestation.

The best results were obtained for unit I, where the drive-yield ratio is 0.78, that is, the liquid taken is greater than the steam and water pumped. Obviously, oil and liquid are taken from the wells of a given unit not only from its own but also from neighboring units. This also explains, evidently, the fairly high intensity of the oil yield, which amounts to 0.30 (see Fig 3).

On the whole for the experimental section the pressurization volume exceeds the yield of liquid by 31 percent. As a result the stratal pressure rises in the region of the experimental section, which increases the flows of wells outside it. During the time of experimental work the working agents (steam and water) were pumped into the stratum in a quantity of 0.11 of the pore volume, and that increased the oil yield from 0.06 at the start of the process to 0.15 by the beginning of 1979. As a result of the great effective thickness and intensified appearance of sand only 60 percent of the thickness is revealed and functions on the experimental section. Therefore if one starts from the working thickness the volume of pressurization of the working agents amounts to 0.18 of the volume of the pores and the oil yield is 0.24.

In spite of the fact that steam drive in combination with flooding on the experimental section of the Kenkiyak deposit is, in essence, in the initial stage, and in spite of technical difficulties, the obtained results confirm the technological effectiveness of the indicated process in the development of an undepleted deposit of high-viscosity oil. In comparison with development in natural conditions the oil yield became 2.5 times as large, an additional 221,000 tons of oil were obtained, and the steam-oil factor in relation to the additionally produced oil does not exceed 3 tons/ton.

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CSO: 1822

UDC 622.276.5.001:550.832

OIL SATURATION STUDY: ROMASHKINO, UST'-BALYK, ARLAN

Moscow NEFTYANOYE KHOZYAYSTVO in Russian No 2, Feb 80 pp 26-29

[Article by M.Kh. Khusnullin, Tatneftegeofizika, S.P. Pustovoyt, Irkenneft' NGDU [Oil and Gas Production Administration], N.A. Pervushina, Arlanskaya PGK, and V.A. Revnivykh, ZapSibneftegeofizika: "Determining the Degree of Oil Saturation of a Bed and Predicting the Percentage of Oil in the Extracted Liquid"]

[Text] In the drilling of extraction wells, we frequently encounter flooded beds that were previously not involved in development because of the danger of the appearance of water. However, the research results presented in this article show that liquid with varying contents of oil and water can be extracted from such beds. In connection with this, when studying the geological profile of wells drilled into flooded sections of oil deposits, it is necessary to solve two problems: determine the water's salinity and the current degree of oil saturation of the flooded beds; determine the feasibility of including the flooded beds in the development process on the basis of a prediction of the percentage of oil in the liquid that will be extracted from them.

Proposals for determining the salinity of the injected water using the phenomenon of the change in the intrinsic polarization (SP) potentials were advanced comparatively long ago [1], but it is only in recent years that methods have been suggested for evaluating the current degree of oil saturation of flooded beds (research carried out by G.S. Kuznetsov and Ye.I. Leont'yev, workers at the Tyumen' Industrial Institute).

In this article we develop these ideas further and discuss for the first time the problem of predicting the percentage of oil in the extracted liquid.

When a productive bed is flooded with injected fresh water that is in contact with the surrounding clay, the SP potentials of the rocks in the well change [1]. The static amplitudes of the SP potentials on the boundaries between the clay and the oil-bearing bed ($E_{s,1}$) and the clay and the flooded bed ($E_{s,2}$) are written in the form

$$E_{s,1} = K_{sp} \lg \frac{\rho_w}{\rho_f}, \quad (1) \qquad E_{s,2} = K_{sp} \lg \frac{\rho_{fb}}{\rho_f}, \quad (2)$$

where K_{sp} = coefficient of the static anomaly of the SP [2]; ρ_w, ρ_{fb}, ρ_f = specific resistances of the waters in the oil-bearing and flooded beds and in the drilling solution filtrate, respectively. Equations (1) and (2) are correct if there is no filtration component E_s and the diffusion-adsorption activities of the surrounding clays are identical.

In wells filled with a clay solution, the depth of penetration of its filtrate into flooded productive beds does not exceed three diameters of the well. In order to fill a coaxially cylindrical zone 0.6 m in diameter and 1 m long in a bed with porosity 0.2, it takes 0.05 m^3 of filtrate. A standard clay solution, with a water yield of 10 cm^3 of filtrate from 300 cm^3 of solution, contains a total of 0.001 m^3 of filtrate in a hole 1 m long. Laboratory measurements have shown that the basic part of the filtrate separates out of the solution in the first 7-10 min alone and that the clay crust becomes impenetrable 2 h after formation. Consequently, by the moment of measurement of the SP potentials, liquid filtration in the well-bed system has ceased, although there does exist a pressure gradient. Therefore, for any specific resistance and a normal water yield from the clay solution, for all practical purposes there is no filtration component E_s.

The equality of the diffusion-adsorption activities of the underlying and covering clays is monitored from adjacent holes that were drilled before the flooding of the bed. Figures 1a and 1b are the SP curves for two wells in close proximity to each other that penetrated a bed before and after it was flooded. The conventional line of the surrounding clays before flooding of the bed is maintained at the same level. After flooding of the bed, static amplitudes $E_{s,1}$ and $E_{s,2}$ were read starting from the line of the covering and underlying clays.

When the bed is flooded, the amplitude of the SP curve decreases over its entire thickness (Figure 1c). In connection with this, the dependence of E_s on the double difference parameter A_γ of the gamma-ray method curve is constructed for the oil- and water-bearing beds, after which the value of A_γ for the flooded bed is used to find $E_{s,1}$. Parameter $E_{s,1}$ is sometimes read from a bed that is analogous to a flooded bed as far as A_γ is concerned.

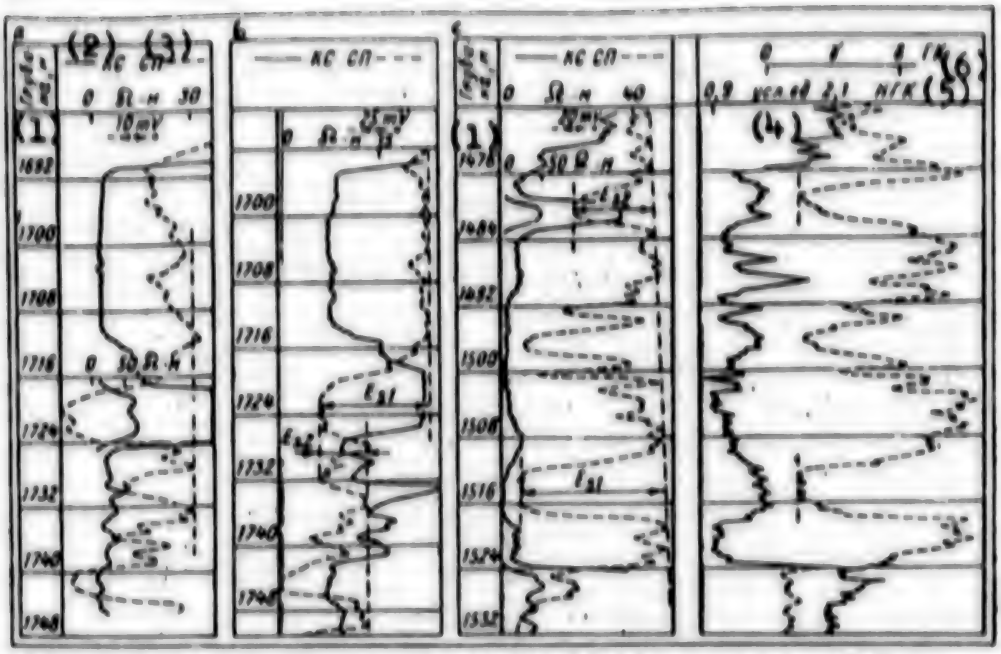

Figure 1. SP curves: a. Well 4379; b. Well 4379a; c. Well 5664.

Key:

1. Depth, m
2. Apparent resistance
3. Intrinsic polarization
4. Arbitrary units
5. Neutron-gamma-ray logging
6. Gamma-ray logging

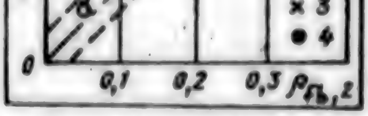

Figure 2. Comparison of specific resistances of waters in a flooded bed, as derived from data obtained by chemical analysis of $\rho_{fb,2}$ and the SP curve $\rho_{fb,1}$. Deposits: 1. Romashkinskoye; 2. Samotlorskoye; 3. Ust'-Balykskoye; 4. Arlanskoye.

Parameter ρ_{fb} is found from the solution of system of equations (1) and (2), which also makes it possible to determine the important petrophysical rock parameter K_{sp}.

Figure 2 shows the values of ρ_{fb} for different deposits, as determined from the SP curve and the results of a chemical analysis of waters removed from flooded beds during testing. The absence of systematic error in the graph -- with the exception of two beds in the Samotlorskoye deposit -- indicates that the filtration component E_s equals zero. The points corresponding to the beds in the Samotlorskoye deposits are shifted along the horizontal axis because of the fact that the beds were tested 9-12 months after the wells were drilled, during which time the salinity of the stratal waters was reduced.

A bed's current oil-saturation ratio is determined with the well known experimentally established relationship [3]

$$K_n = 1 - \sqrt[2.26]{\frac{0.6\rho_{в}}{\rho_p K_p^2 P}}, \qquad (3)$$

where ρ_p = specific resistance of a bed with porosity K_p; P = = coefficient of surface conductivity.

When the salinity C of the saturating water is reduced from 300 to 1 g/ℓ, the surface conductivity P of samples of Devonian sandstones from the Romashkinskoye deposit increases from 1 to 1.38, and in the coordinate system lg C, P has a linear form. However, the calculation of K_n for flooded beds, using formula (3) and allowing for P, gives values of the ratio that are too high. Complete core samples were taken from evaluational wells Nos 4997 and 8577, from completely flushed beds. During testing, desalinated water with oil films was obtained from these beds. The results of calculations of K_n by formula (3), without allowing for P, show good convergence with the K_n values derived from data obtained by electrometry, core sampling and pulsed neutron logging (see table on next page).

The determination of the value of K_n for flooded beds creates the prerequisites for predicting the percentage of oil in the extracted liquid. The feasibility of involving such beds in development has been established on the basis of this. Filtration of the water-oil mixture takes place in a flooded bed. When the filtration is steady, Darcy's Law is observed for each of the phases [5].

Numerous experimental investigations have shown that the relative phase permeabilities for oil $f_n(K_n)$ and water $f_w(K_w)$ depend on the oil-saturation ratio and the rock wettability of each of the phases and is independent of their viscosities and filtration rates for oil $\vec{v}_n$ and water $\vec{v}_w$.

When the filtration law is linear, rates $\vec{v}_n$ and $\vec{v}_w$ are proportional to the oil (Q_n) and water (Q_w) yield rates. Consequently, the percentage of oil in the liquid can be determined from the relationship

$$\frac{Q_n}{Q} = \frac{1}{1 + \frac{\mu_n f_w(K_n)}{\mu_w f_n(K_n)}}, \qquad (4)$$

where Q = flow rate of the liquid extracted from a flooded bed when it is included in the development process.

(1) № скважины	(2) Интервал исследования пласта, м	$\rho_{вп}$, Ω·м, по (3)		ρ_p, Ω·м	K_p, по (3)		K_n, по (3)			Доля нефти в жидкости (9)		
		СП (3)	химическому анализу (4)		керну (5)	геофизике (6)	керну (5)	электрометрии (7)	импульсному нейтрон-нейтронному каротажу (8)	расчетная (10)		по результатам опробования (13)
										по кривым Леверетта (11)	по корректированным кривым Леверетта (12)	
					Ромашкинское месторождение (14)							
4 997	1753—1756,4	—	0,26	7	0,21	—	0,26	0,26	—	0,02	0	0
8 577	1713—1722	—	3	100	0,204	—	0,27	0,31	0,31	0,02	0	0
14 072	1670,2—1673,8	0,15	0,16	13	—	0,22	—	0,58	—	0,57	0,42	0,46
14 073	1629,6—1632,8	0,123	0,26	10	—	0,20	—	0,53	—	0,39	0,21	0,38
13 959	1679,6—1682	0,267	—	20	—	0,20	—	0,51	—	0,33	0,14	0,10
14 090	1707,6—1710,8	0,229	—	13	—	0,20	—	0,45	—	0,18	0,05	Не рекомендован к испытанию (15)
					Усть-Балыкское месторождение (16)							
456	2177,6—2183,2	0,26	0,26	34	—	0,21	—	0,64	—	0,72	0,65	0,60
462	2131,2—2132,6	0,22	0,3	10	—	0,22	—	0,4	—	0,34	0,03	0,01
664	2297,6—2300	0,28	0,45	9	—	0,23	—	0,37	—	0,08	0	0,1
666	2269,2—2271,6	1,08 0,85	—	20	—	0,21	—	0,17 0,22	—	0,07	0	0
699	2171,6—2180	0,3	0,31	12	—	0,25	—	0,47	—	0,13	0,04	0,12
					Арланское месторождение (17)							
5 664	1478,4—1482,4	0,195	0,19	15	—	0,23	—	0,57	—	0,15	0,09	0,19
5 661	1338,8—1341,2	0,579	—	25	—	0,245	—	0,48	—	0,07	0,01	0,08
	1341,2—1344	0,303	—	12	—	0,245	—	0,46	—	0,01	0,01	0,03
5 582	1281,6—1284,8	0,222	—	30	—	0,24	—	0,68	—	0,75	0,72	0,62
5 581	1264,4—1267,6	0,139	—	14	—	0,25	—	0,65	—	0,44	0,38	0,39
5 438	1249,6—1254,8	0,12	0,12	11	—	0,25	—	0,63	—	0,38	0,26	0,04

Key:

1. Well No
2. Interval of bed investigation, m
3. ....., according to
4. Chemical analysis
5. Core sampling
6. Geophysics
7. Electrometry
8. Pulsed neutron logging
9. Percentage of oil in liquid
10. Theoretical
11. By Leverett curves
12. By corrected Leverett curves
13. By results of sampling
14. Romashkinskoye deposit
15. Not recommended for testing
16. Ust'-Balykskoye deposit
17. Arlanskoye deposit

For given values of K_n, the values of $f_n(K_n)$ and $f_w(K_w)$ in (4) are found according to the phase permeability curves, it being the case that Leverett's phase permeability curves [5] provide the greatest accuracy for calculations with this formula; that is, the best convergence with the results obtained by sampling. However, Leverett's curves need correcting.

In 1967-1968, the residual oil saturation of flooded beds in 41 wells in the Tataria oil fields was investigated by the pulsed neutron logging method [4]. The liquid extracted at the time of the investigation contained no more than 1-2 percent oil; that is, the relative phase permeability for oil was close to zero. For these wells the average oil-saturation ratio was 0.38. For two points with coordinates (K_n = 0.38, $f_n(K_n)$ = 0) and (K_n = 0.7, $f_n(K_n)$ = 0.5), and allowing for the curvature of the Leverett function, the phase permeability curve for oil was plotted. Henceforth we will call this the corrected Leverett curve (Figure 3).

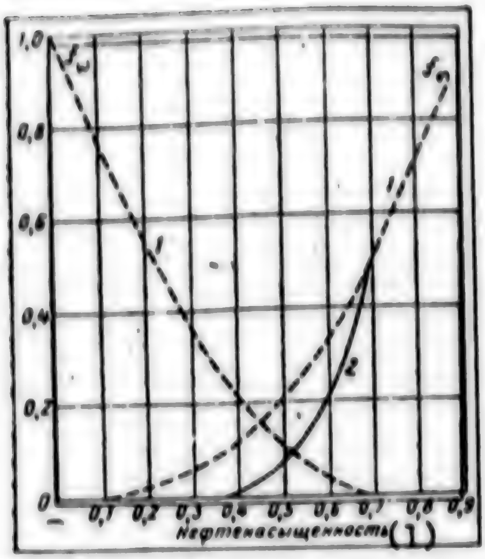

Figure 3. Leverett curves of relative phase permeabilities for oil and water: 1. normal; 2. corrected.
Key: 1. Oil saturation

The table on the preceding page shows the percentage of oil in the liquid extracted from the flooded beds. The figures were obtained by calculations and by sampling in three deposits with different geological conditions and stratal fluid properties. An analysis of the data obtained shows that calculations of the percentage of oil using the corrected Leverett curves gives the best coincidence with the results obtained by sampling. Several results that were too high were obtained when the percentage of oil was determined with uncorrected Leverett curves. The phase permeability curves of D.A. Efros and V.M. Berezin are unsuitable for predicting the percentage of oil in the extracted liquid, because the former produces calculative results that are much too high, while the latter yields results that are too low. The introduction of a correction factor for surface conductivity when determining the oil-saturation ratio also overstates the theoretical percentage of oil in comparison with the data obtained by testing the beds.

Extensive sampling and the introduction into practice of the proposed technique for determining the current degree of oil saturation and predicting the percentage of oil in the extracted liquid will make it possible to involve in development flooded beds from which it is expected that a profitable level of oil extraction will be obtained. This will make it possible to increase the oil yield and the amount of oil extracted.

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FUELS

DEPUTY COAL MINISTER INTERVIEWED ABOUT STATUS OF STRIP MINING

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 23 Apr 80 p 2

[Interview with Deputy USSR Minister of Coal Industry Mikhail Ivanovich Shchadov by N. Goncharov, editor of the newspaper's heavy-industry section: "Coal from the Strip Mine"]

> [Text] A letter about how we are developing the country's coal mining with strip mines that will interest readers has arrived in the editorial office. In particular, Ye. Serdinov from Gorlovka, Donetskaya Oblast, writes: "It was said at the 25th CPSU Congress that during this five-year plan 60 percent of all the increase in coal mined in the USSR will be obtained by the strip-mining method. How is this task being met? Why is so much attention being paid to this particular method of mining coal?"
>
> Today our correspondent conversed on this topic with Deputy USSR Minister of Coal Industry M. Shchadov.

Answer: As experience indicates, said Mikhail Ivanovich, mining coal by the strip-mining method is far cheaper, more productive and incomparably safer than at underground mines. This is why open-cut operations are preferable. Let us compare these indicators: last year labor productivity for workers at strip mines was 9.2-fold higher than at underground mines, and the cost per ton of coal was two-ninths as great. I think that even these comparisons are enough to make clear why we consider the open-cut method the main trend in coal-industry development. Today, almost all growth in coal mining is obtained by the branch through open-cut work.

Question: Indeed, a well-known decrease in underground mining has been occurring these days. Most of the industry's underground mines require rebuilding. And this is going on slowly. And the transfer to deeper horizons and to more difficult seams has brought no few complexities to underground mining operations. So the share of underground mining in the increase of fuel obviously has lessened, while the indicator for open-cut work has leaped up.

Answer: This is true only partially. The industry is continuously increasing the amount of coal mined by the open-cut method: its growth during the first 4 years of the Tenth Five-Year Plan was almost 33 million tons. While the overall plan for USSR Minugleprom [Ministry of Coal Industry] for last year was not carried out, as is known, the strip miners exceeded their plan by 3 million tons. The share of open-cut mining during the first 4 years of the Tenth Five-Year Plan increased considerably and now is 36 percent of the total of fuel mined.

Question: There are other computations and comparisons, Mikhail Ivanovich. The share of open-cut operations in the coal industry nevertheless is lower than in other mining branches of industry, let's say, in USSR Minchermet [Ministry of Ferrous Metallurgy]. Why?

Answer: In my opinion, this can be explained by the relative youth of strip mining in coal production and the somewhat slow shifting of attention to its needs. However, our subbranch has now acquired such influence in the national economy that it is impossible to ignore its needs. It has been proven convincingly where it will be possible to get more coal more quickly at less expense. Extremely indicative here is the well-ordered operation of our Red Banner collectives, particularly the Tsentral'nyy Strip Mine in Ekibastuz, the Nazarovskiy in Krasnoyarskugol' [Krasnoyarskiy Kray Coal-Mining Association] and the Kharanorskiy in Vostsibugol' [East Siberian Coal-Mining Association]. Their experience is being studied tirelessly at other enterprises. A competition of equipment operators for high work indices is being developed. Such masters of strip-mining operations as N. Konovalov, senior equipment operator of the Cheremkhovskiy Strip Mine, member of the Irkutskaya Oblast CPSU Committee and deputy of the RSFSR Supreme Soviet, V. Solov'yev, brigade leader of the Strip Mine imeni 50-Letiya Oktyabrya of the Kemerovo Coal-Mining Association and deputy of the RSFSR Supreme Soviet, P. Cherpakov, brigade leader of the Nazarovskiy Strip Mine and USSR State Prizewinner and others have achieved unprecedented results during the Lenin anniversary drive. The brigades of N. Konovalov and V. Solov'yev have already met their five-year goals. High productivity has not been reached by 353 of our excavating brigades.

Question: These figures, Mikhail Ivanovich, are not so significant if one considers that altogether there were 1,590 excavator brigades at open-cut mines at the start of this year. It turns out that in the 10 years of competition of the equipment operators, only a little more than 22 percent of them had achieved a high workload. Moreover, in the first 5 years the number of advanced brigades increased more quickly, reaching 249 in 1975, but during the five following years the increase was 104 brigades. The task of Minugleprom's board and of the industry's trade union with regard to converting brigades to a higher operating class sometimes is interrupted. Isn't advanced experience at open-pit operations being propagated slowly? Last year 11 strip mines that fell in arrears by more than 3 million tons of coal did not cope with plan tasks, and 22 strip coal mines, or almost one-third of the total, lagged in assimilating capacity. Because of this, the industry lost 11.8 million tons of coal during the year. And in the current first quarter the lagging Ekibastuzugol' [Ekibastuz Coal-Mining Association] and Dal'vostugol' [Far Eastern Coal-Mining Association] marred a favorable picture.

Answer: Yes, there are still many organizational and other deficiencies at open-cut operations. We know what they are. Indisputably, if we had brigades that were much more productive throughout the whole industrial chain the economic indicators would become much better and there would be fewer lagging subunits. Certain managers of strip mines and associations behave at times with coolness toward the needs of brigades that have converted to heightened operating regimes and do not inform the participants in this competition in good time about the final results. As for the weaknesses of our system for repeating advanced experience, then I would prefer to converse more concretely.

Question: Good, Mikhail Ivanovich. Two years ago technical director V. Zhdamirov of Vostsibugol' shared in our paper the experience of organizing unified operating complexes at the Yuzhnyy Strip Mine. However, the useful innovation did not find proper support. Yesterday, here in the ministry, I met Zhdamirov and found out that he had managed to introduce the new work organization in only 3 brigades. In 2 years the valuable strip-mine experience was repeated altogether in one collective!

Answer: Obviously, I cannot dispute that there is a known conservatism here. But Zhdamirov knows well that there is not enough equipment, particularly of bulldozers and drill rigs, which the integrated brigades cannot do without. And so it is necessary, as they say, to cut the suit to fit the cloth. But the "suit," to speak frankly, is not large.

USSR Gosplan and Gossnab allocate us far less equipment and far fewer spare parts than are required. Uralmash, the Novokramatorsk Machinebuilding Plant of Mintyazhmash [Ministry of Heavy and Transport Machine Building], the Izhorskiy Plant of Minenergomash [Ministry of Power-Engineering Machine Building], the Novocherkassk Electric-Locomotive Building Plant of Minelektrotekhprom [Ministry of Electrical Equipment Industry] and others are not fulfilling their contractual commitments with precision.

I no longer speak about the low quality of certain machines. Major structural design flaws have shown up, for example, in high-powered rotary excavators. One of these giants, the ERP-2500, stood idle for "finishing work" at Ekibastuz for many work-hours.

Question: However, we have messages about the fact that at times there is an unthrifty attitude toward equipment at the strip mines, that competition for the effective and economical use of it is not free of formalism. And, meanwhile, you, Mikhail Ivanovich, somehow get around this aspect of the matter. Surely, it is not accidental that you did not recall the more powerful Ekibastuz excavator, the one on which E. Fetser's brigade is working. It, according to the report of our own correspondent B. Glotov, stands idle at the Bogatyr' Strip Mine about one third of the worktime. When this was being investigated, it was explained: this gigantic machine is repaired poorly and not on time. For this reason alone last year it was inactive more than 1,000 work-hours, and the statement of coal lost is already in the millions of tons. In the first quarter, more precisely on 14 February, our correspondent V. Bobrov at the Kedrovskiy Strip Coal Mine observed an extremely typical picture: at the third section, where S. Deryabin was in charge, four dump trucks in good operating order came and also were idle for a long time without business--excavator No 1 was not ready for operation.

Answer: What you are describing here is, of course, irresponsibility.

Question: I agree with you, Mikhail Ivanovich. Don't you somehow find this little episode symbolic?

Answer: Just what do you have in mind?

Question: A pronounced lack of coordination in the times fixed for carrying out mutually related operations, primarily preparatory, mining and transport operations.

Answer: I will not hide the fact that we have a situation that at times is actually worrisome. The preparation of coal reserves for excavation, or, as we call it, stripping operations, lags greatly behind the mining, and we sometimes cannot eliminate these disproportions. While during the Eighth Five-Year Plan the average annual pace in growth of stripping operations outstripped mining work by more than 1 percent and during the Ninth by only one-tenth of a percent, under the current plan this has been reduced by 2.8 percent. The overall lag at strip mines of the Kuzbass [Kuznetsk Coal Basin], Ekibastuz and Krasnoyarsk has reached 400 mm million cubic meters of overburden. According to our computations, it would be possible to correct the situation with the existing manpower if good dump trucks of higher unit capacity were furnished us more quickly. The matter of sending out the coal clearly is unfavorable. The Ministry of Railways does not allocate us enough freight cars, and it delivers them irregularly. Because of this, for example, in Ekibastuz in one year alone they were unable to send out 3 million tons of fuel, and the operating rhythm was constantly being broken. In Kemerovougol' [Kemerovo Coal Mining Association], literally mountains of unshipped coal are piled up. They grow by the day: in the first quarter alone another million tons of dead freight were deposited at the storage areas, and more than 4 million tons of it in all are lying there right now. And this at a time when there is not enough fuel in the country! The people who mined this coal by the sweat of their brows see it burst into flame spontaneously at the storage sites and lose commodity value when spring water carries it away in places. One can scarcely calculate which is the greater damage--moral or economic. We have become so "overstocked" at Kuzbass strip mines and so disorganized through the fault of MPS [Ministry of Railways] that the coal industry was forced to go to an extreme measure--to cut down on coal mining at some places.

Question: We share your concern and we intend that it will be heard. But we put this question to you: what are the prospects for developing open-cut operations?

Answer: We trust that USSR Gosplan will examine his preliminary draft plans for the Eleventh Five-Year Plan, for that which he intends to give the strip miners has in no way been written into our plans for equipment updating of the subbranch. We trust also that the State Committee for Science and Technology will take decisive measures to speed up the development, creation and introduction of basically new superpowerful equipment for strip mining. These periods are being drawn out for 8-12 years and they positively do not suit us. We trust, finally, that experimental models of the newest equipment created in our industry's institutes for the mechanization of labor-intensive subsidiary work at strip coal mines will be adopted at last for serial manufacture at Mintyazhmash, Minstroydormash [Ministry of Construction, Road and Municipal Machine Building] and MPS plants.

The industry's scientists should solve strip mining's severe problems more energetically.

We link our best hopes with the creation of mighty fuel and power complexes--Ekibastuz, Kansk-Achinsk and South Yakutia, where strip coal mining will reach a level never before seen and be really improved. SOTSIALISTICHESKAYA INDUSTRIYA constantly tells readers about the progress of work at these complexes. So I will say briefly: despite various particular successes, we are still dissatisfied with the deadlines for erecting facilities there, the quality of the work, the prevailing level of collaboration of the industry, the pace of recruitment of workers and the creation of normal production and living conditions for them. The builders are letting us down considerably. We often delete from the schedule, it seems, strip mines due for startup that had already been incorporated in the plan.

Question: Mikhail Ivanovich, still another letter on the theme of our conversation has come to the editors' office. Engineer B. Rudayev writes that recently he was at the Kedrovskiy Strip Mine of Kemerovougol' on a field trip and was surprised at the wastefulness with which a coal seam was being excavated there: the main portion of it, in the reader's words, "goes straight to the rock dump!" And the author later remarks: "the miners at times drop down to a depth of a kilometer to take out a half-meter coal seam, but the Kedrovskiy miners, without rhyme or reason, each year send to the dump, along with rock, hundreds of thousands of tons of fuel from a four-meter seam." What kind of a mining method is this?

Answer: Such a sin occurs. Actually, at the Kedrovskiy and also at certain other places, coal members also fall into the rock dump along with rock that has been stripped. The seam there is not continuous, but is apparently faulted with thin interlayers of rock, and, with existing machinery, selective excavation is impossible. An upgrading installation is extremely necessary in order to get the coal from the rock mass and to sort it. But it has been under construction at the Kedrovskiy Strip Mine for 11 years now, and the end of its construction is not in sight: only about half of the resources released for its erection have been assimilated.

Question: Whom are you, the deputy minister, complaining about? Your builders?

Answer: It turns out we are complaining about ourselves.

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FUELS

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ENERGY CONSERVATION IN THE COAL INDUSTRY

Moscow UGOL' in Russian No 3, Mar 80 pp 20-22

[Article by A.P. Sakharov, candidate of technical sciences, TsNIEIugol': "On the Conservation of Fuel and Energy Resources in the Coal Industry"]

[Text] During the period of construction of the material and technical base of a communist society, a country's fuel and energy resources and the industrial branches responsible for extracting and processing them play an important role in the national economy. The technical and economic policies of a country, constructive technical and technological progress in industry and transportation, and measures for increasing the degree of economy in the utilization of natural energy sources are all reflected in the fuel and energy balances.

The successes achieved in the development of the USSR's economic system are inextricably related to the coal industry, which fulfills this country's continually growing requirements for coking and power coals. Even the outstripping development of the gas and oil extraction industries did not diminish the part played by coal in satisfying the fuel requirements of our country's national economy. The largest consumers of coal are heat and electric power stations, industrial and regional boiler rooms, ferrous metallurgy plants, and the municipal and domestic sector.

At the present time, in the USSR the requirements for fuel and energy resources are estimated to be more than 2 billion tons of conventional fuel. For the national economy as a whole, as the result of work that has been and is being done to reduce fuel and energy consumption, the relative requirement for fuel is being reduced by more than 20-25 million tons of conventional fuel every year, including 10-13 billion kWh of electricity and 62.8-104.7 PJ [expansion of "P" unknown] of thermal energy, in comparison with the norms for the preceding year[1]. In 1979, plans were made for a total savings of fuel and energy resources in the national economy amounting to 33 million tons of conventional fuel. Keeping in mind the exceptional importance of the rational use of fuel and energy, in coming years it will be necessary to look for opportunities to conserve organic fuel in all branches of the national economy.

CC CPSU General Secretary and Chairman of the Presidium of the USSR Supreme Soviet Comrade Leonid Il'ich Brezhnev has repeatedly mentioned the importance of the problem of fuel conservation, and at the November (1979) Plenum of the CC CPSU again indicated that "...no matter what the rate at which we develop power engineering, in the future fuel and energy conservation will continue to be a most important nationwide problem."

Considering the extraordinary importance of the problem that has been placed before us, it is advisable to conduct the development of measures for the conservation of fuel and energy resources in the coal industry in the following directions:
in coal extraction and enrichment -- reduce the amount of coal left in the ground by introducing improved exploitation systems and improving the organization of the work; reduce operational losses of coal; reduce the specific energy-intensiveness of coal extraction by replacing and modernizing extraction and mine transportation equipment, improving production processes and making better choices of energy carriers;
in coal transportation and storage -- reduce the amount of liquid fuel and electricity used to transport coal by reducing the tractive resistance of transportation facilities (by building higher quality roadways, improving the tuning of fuel equipment for engines, introducing progressive methods for handling strings of railroad cars, increasing the load factor and reducing the number of empty runs for all types of transport); improving the maintenance of transport facilities; reducing coal losses during storage in warehouses;
in the use of fuel and energy by consumers -- reduce the amount of fuel, electricity and heat consumed per unit of production output; reduce fuel and heat losses by centralization of the heat supply for large residential areas, the timely preparation and repair of heating systems and integrated preparation of residential and domestic premises for the heating season; curtailment of losses of electrical and thermal energy and fuel as the result of improvement of the accounting system and standardization of their consumption by consumers.

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[1] "Methods for Saving Fuel and Energy in a Planned Economy," PLANOVOYE KHOZYAYSTVO (The Planned Economy), No 2, 1979, pp 3-8.

The most important requirement in our present stage is to improve the level of integration and completeness of utilization of coal, both when it is being extracted from the ground and during its subsequent enrichment (processing), distribution and consumption.

In the coal industry, in the extraction process special attention must be given to the problems involved in increasing the level of extraction of coal and shale reserves from the ground. Just by partially removing the coal from protective pillars and implementing measures for the protection of structures being developed, it will be possible to obtain millions of extra tons of coal. Pillarless methods for working coal beds will make it possible to eliminate coal losses in the supporting pillars between fields that are being developed, and such losses constitute 30-80 percent of all the operational losses when standard technology is used. However, all the coal is still not being removed from the ground. When underground extraction methods are used, about one-fifth of the industrial reserves are left in the ground at the present time. If we could succeed in eliminating these losses, we would be able to avoid having to develop many new fields. The related savings in capital investments would be greater than the expenditures for reducing coal losses in the ground. At the same time, the question of the optimum level of losses is far from being a simple one. The introduction of development systems with filling of the worked-out area, which systems provide for more nearly complete working of reserves under complex geological mining conditions, requires additional capital investments.

Analysis shows that for the branch as a whole, the total losses of coal in the ground during the extraction process are decreasing every year. In 1978, for example, the coal and oil shale losses decreased by about 8 percent in comparison with 1970. Coal losses in the ground are most significant when the underground mining method is used; for open-pit mining they average only one-third as much, although even for this method much coal goes into the tailings along with the removed rock or is left in unworked beds that are classed as substandard. As the scale of coal extraction by the open-pit method grows, the volume of coal losses in the ground and in tailings increases systematically. Much coal is lost, for example, in the Kuznetsk Coal Basin, where a significant part of the valuable grades is located in beds that, because of their thickness, are classified as substandard at the present time. In the Ekibastuz basin, every year about 3 million tons of coal with a combustion heat averaging 14,654 kJ/kg go into the tailings along with rock removed during intrabed stripping. This can hardly be right if we consider that the combustion heat of the coal or oil shale being mined at the present time in (for example) the Moscow area is considerably lower.

It is necessary to develop measures for the more nearly complete extraction and utilization of our natural coal resources. To this end, we should perform a special technical and economic analysis of the existing conditions in the coal beds and of the coal losses in the country's leading coal basins, with this analysis being oriented on the fuller and more integrated enlistment of this fuel in utilization for national economic purposes.

Considering the significant material, labor and financial expenditures involved in coal mining, it is extremely important to insure its subsequent rational use with minimum waste and the best final results. In order to achieve this, further development of the deep processing of solid fuel is needed, along with the production from coal of enriched, high-efficiency types of fuel and other valuable products. It would be advisable to increase our attention to questions related to the integrated thermal processing of solid fuel. The reason for this is that the volume of extraction of relatively cheap but low-calorie brown and pit coal is increasing continually, particularly in the eastern regions of the country. An increase in the extraction of oil shale has been specified. The direct burning of brown coal and oil shale results in a low utilization factor for them, increase wearing of power engineering equipment, and a negative effect on the environment. The efficiency of the utilization of low-calorie coals and oil shale increases significantly if they undergo thermal processing into liquid, gaseous, or high-calorie solid fuel.

One of the possible sources for replenishing our fuel resources is methane, which is a concomitant component found when coal is extracted by the underground method in many basins in this country. At the present time, more than 1.3 billion m^3 of methane is recovered in the USSR. However, its utilization factor is still low and is only about 18 percent. Nevertheless, as research has shown, there exist definite reserves for both extracting methane from the ground during the development of coal beds and for increasing its utilization factor. In the coal industry, several boilers of different designs are run on captured methane. We think that as the degasification of mines and the capturing of methane become more organized, it will be used on wider scales in local industrial boilers in place of the fuel that is traditionally burned.

Significant reserves for fuel and energy economy are possible as a result of improvements in the distribution of different types of fuel to consumers for the purpose of insuring the maximum effect for each ton of conventional fuel that is used, as well as reduction in coal and electrical and thermal energy losses, and improvements in fuel- and energy-consuming equipment, technology and standards for the purpose of reducing fuel and energy consumption per unit of output.

The quality of the coal delivered to consumers affects its economy to a considerable degree. For instance, when sorted gas coal and anthracite are burned in heating furnaces, the level of their utilization effectiveness is 18 and 30 percent higher, respectively, than when unsorted coal with a high content of fines is used.

Much heat is lost because of the imperfection of furnaces and the equipment in small boiler rooms. A definite savings of fuel and energy resources can be achieved by introducing into the coal industry efficient generating and fuel- and energy-using equipment, as well as progressive production processes and installations and machinery with low specific fuel and energy consumption rates per unit of production output or work performed, and by the modernization of obsolete equipment.

Several thousand boilers for industrial and municipal-domestic needs have been installed in various elements of the coal industry. In our opinion, the modernization of existing boilers and the replacement of obsolete designs with modern ones will make it possible to burn fuel most rationally. An effective method from the viewpoint of fuel economy is the conversion of boilers from layered burning to the combustion of fuel in a "boiling" layer. Experience in operating boilers with fire boxes in which anthracite culm is burned in the boiling layer shows that because of the intensification of the combustion process, the boiler's efficiency can be increased by about 10 percent.

By disconnecting consumers who receive all or part of their electricity from electric power stations under the jurisdiction of USSR Minugleprom [Ministry of the Coal Industry] and connecting them to power systems operated by USSR Minenergo [Ministry of Power and Electrification], it will be possible to achieve a considerable savings of fuel. In our opinion, it is necessary to do this because the power stations mentioned above have a high specific fuel consumption rate per kilowatt-hour of generated electricity. For instance, in the Sakhalinugol' and Aleksandriyaugol' associations, the specific conventional fuel consumption rate for the generation of electricity is higher than in the heat and electric power stations of USSR Minenergo by factors of 3.6 and 2.4, respectively.

A considerable amount of electricity is used in enterprises belonging to the USSR's coal industry. Despite the growth of mechanization, an increase in the equipment power available per worker, a transition in mining operations to deeper levels, and an increase in the amount of stripping work needed in the pits, as a result of an intensified economy regime and an increase in the amount of work done by the open-pit method, for a number of years the specific consumption rate of electricity for the extration of coal has remained at almost the same level.

However, there still exist further possibilities for saving electricity by:
converting underground electrical transducers from 380 V to 660 V, which will make it possible to improve the moment characteristics of the electric motors used to drive the mining machinery and, consequently, to increase their productivity;
converting facing machines from 660 V to 1,140 V, which will make it possible to increase their productivity and the effectiveness of their use by increasing the drives' unit power for given dimensions that are limited by the strictures of use in underground workings;
expanding the use of electricity instead of pneumatic energy at development and working faces during the development of steeply pitched beds;
improving the reactive power factor in order to maintain its optimum value in power system load junctions, including the use of the introduction of automated systems for controlling the power supply to mines and pits;
replacing the existing main ventilation fans in mines with new series of fans with higher efficiency ratings.

In our opinion, it is possible to economize on thermal energy in the coal industry both by regulating its consumption and as the result of changing the structure of the coal extraction process by the open-pit and underground methods.

The basic consumers of thermal and electrical resources in the branch's industrial railway transport sector are the locomotive fleet, which move coal and other cargoes, and subunits of other services that support the operation of the transportation system (the installation of signalization, centralization, block and communication systems, locomotive and freight car depots for repairing rolling stock, service buildings and so on).

It is obvious that the basic measures aimed at economy of fuel and energy resources in industrial transport can be:
the conversion of the transportation system to thermal and electrical traction;
the introduction of scheduled trains;
improvement in the structure of the locomotive fleet that

insures the introduction of more economical types of steam and electric locomotives with regenerative braking;
the creation of special cars for transporting coal;
improving the technical state of railway lines, introducing seamless tracks, and increasing the weight norms for trains;
the construction of installations for the application of protective films and the use of rollers -- packers -- to prevent coal losses because of wind erosion during transportation in railway cars.

Energy resources in industrial motor vehicle transport can be saved by reducing motor fuel consumption norms through the introduction of more economical engines and motor vehicles with increase cargo capacities, increasing the load factor by using trailers and reducing the number of empty runs, developing and improving the motor vehicle road network, increasing the percentage of cargo transportation by diesel-powered vehicles, improving fuel storage and distribution procedures, and so on.

There also exist reserves for fuel economy in coal enrichment mills. For instance, modernization of the equipment complex and automation of the drying units, sealing, thermal insulation and reduction of the hydraulic resistance in drying chutes, and the introduction of more efficient drying equipment with a high unit productivity will make it possible to achieve a significant saving of fuel.

An improvement in the management mechanism will offer broad opportunities for creative scientific research on the problem of economy of fuel and energy resources and achievement of the maximum economic effect in the national economy.

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FUELS

USSR GOSPLAN RESPONDS TO READER CRITICISM

Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 4 Apr 80 p 2

[Article by V. Filanovskiy, member of the USSR Gosplan]

[Text] The USSR Gosplan has examined the articles of L. Kostylev and V. Noskov "Difficult Gas of the Polar Region" and "Relay Race of Preeminence" published by the newspaper SOTSIALISTICHESKAYA INDUSTRIYA on 22 and 23 January 1980. In the last 10 years in the Tyumenskaya oblast a lot of work has been done to increase the extraction of oil and gas, and the prerequisites have been created for the further development of oil and gas industries. The main increases in extraction of oil, gas and condensate are expected precisely in the Tyumenskaya oblast.

To solve this major national economic task it remains in future years to put tens of new oil and gas fields here into industrial development, and increase the extraction on the already developed fields. In particular, it is planned at the unique Urengoy field to increase the annual extraction of gas to 185 billion cubic meters versus 24.7 billion cubic meters actually extracted last year.

The high rates of increase in gas extraction at Urengoy, the severe natural and climate conditions, the insufficient facilities of the contracting construction and installation organizations, and a number of other reasons have resulted in the fact that on the background of the general lagging in construction of facilities of production and nonproduction purpose the social, cultural and general facilities, and in the first place, housing, are being built extremely slowly.

Primary importance is attached to the questions of comprehensive development of the oil and gas fields of West Siberia, including Urengoy. Therefore the USSR Gosplan stipulates specific assignments for the appropriate ministries and departments directed towards a radical improvement in the situation in this region concerning exploration, drilling, construction of oil and gas extracting enterprises, energy supply facilities, resources of transportation and communication, and residential-communal services and social, cultural and general services.

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FIFTIETH BIRTHDAY OF BORIS FEDOROVICH KALMYKOV

Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 p 9

[Unsigned Article]

Recently, the society of the Ministry of the Gas Industry celebrated the 50th birthday of Boris Fedorovich Kalmykov.

After completion of the Tashkent Institute of Railroad Transportation Engineers in 1952, B. F. Kalmykov worked diligently at a number of construction enterprises. He worked as foreman, superintendent, senior superintendent and then chief engineer of the administration in the construction trust of the USSR Ministry of Construction in Dushanbe.

In 1959 he was chief engineer of the "Promstroy" trust of the Ministry of Construction of the Tadzhik SSR; in 1961 he was chief engineer of the SMU-5 Construction Administration of the "Mosoblstroy" trust of Glavmosoblstroy in Chekhov of Moscow oblast. Since 1963 B. F. Kalmykov has successfully worked as chief engineer in one of the trusts of the Glavtsentrostroy of the RSFSR Ministry of Construction in Serpukhov.

The energy and initiative combined with high technical skills have made it possible for communist B. F. Kalmykov to solve the most serious production problems successfully.

Since 1970 the labor activity of B. F. Kalmykov has been continuously connected with the gas industry. He was named chief engineer of the "Tsentrgazpromstroy" trust of the Ministry of the Gas Industry; since 1973 he has worked diligently with great knowledge of his business, industry and high responsibility in the job of chief engineer of the Administration of Capital Construction. At the present time he is head of the Administration of the Design Advisory Board.

Boris Fedorovich Kalmykov is an intelligent leader full of initiative, a talented production organizer. His high business qualities, rich production experience, engineering knowledge, high principles and exactingness combined with a benevolent attitude toward people have won him great respect among the branch workers.

B. F. Kalmykov is a member of the board of editors of the GAZOVAYA PROMYSHLENNOST' [Gas Industry] Journal, and his practical assistance in the selection of useful materials for publication to a great extent promotes the fact that the journal is published on the necessary scientific and political-ideological level.

For his great contribution to the development of the gas industry and in connection with his 50th birthday, the board of the Ministry of the Gas Industry and the Presidium of the Central Committee of the Trade Union of Oil and Gas Industry Workers have conferred the rank of "Honored Worker of the Gas Industry" on Boris Fedorovich Kalmykov.

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BRIEFS

GAS INDUSTRY GOALS IN 1980--Natural gas extraction in the USSR, billions of m^3... 435; Volume of complex natural gas refining, billions of m^3... 62.3; Natural gas extraction in the Tyumen Oblast, billions of m^3... 148; Growth of productivity of labor reduced to 1975 level, %... 144.7. [Text] [Moscow GAZOVAYA PROMYSHLENNOST' in Russian No 1, Jan 80 pp 2-3] 10845

FINDING PIPELINE DAMAGE--How can one precisely find the site of gas pipeline damage if the lines are hidden underground? For this it is necessary to look for methane in the air about the route. This is the method used to examine the main gas pipelines by the portable laboratory "Iskatel'-1" created by the joint efforts of the scientists and designers of the SKB [special design office] of the VNPO [all-union scientific production association] "Soyuzgazavtomatika," the Moscow Engineering and Physical Institute and the PTO [production-technical association] "Polyaron." Its equipment is mounted on the four-wheel drive vehicles "GAZ-66" or "UAZ-452." The search tool is a helium-neon laser. Its beam during movement of the machine along the gas pipeline "probes" the air layer above the pipes. And the gas analyzer determines from the degree of absorption of the light stream whether there is methane in the air. "Iskatel'" copes well with its duties both in cold and in heat. [Text] [Moscow SOTSIALISTICHESKAYA INDUSTRIYA in Russian 3 Apr 80 p 4] 9035

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END

SELECTIVE LIST OF JPRS SERIAL REPORTS

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USSR REPORT: Agriculture
USSR REPORT: Economic Affairs
USSR REPORT: Construction and Equipment
USSR REPORT: Military Affairs
USSR REPORT: Political and Sociological Affairs
USSR REPORT: Energy
USSR REPORT: International Economic Relations
USSR REPORT: Consumer Goods and Domestic Trade
USSR REPORT: Human Resources
USSR REPORT: Transportation
USSR REPORT: Translations from KOMMUNIST*
USSR REPORT: PROBLEMS OF THE FAR EAST*
USSR REPORT: SOCIOLOGICAL STUDIES*
USSR REPORT: USA: ECONOMICS, POLITICS, IDEOLOGY*

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USSR REPORT: Life Sciences: Biomedical and Behavioral Sciences
USSR REPORT: Life Sciences: Effects of Nonionizing Electromagnetic Radiation
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WORLDWIDE REPORT: Law of the Sea
WORLDWIDE REPORT: Nuclear Development and Proliferation
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*Cover-to-cover

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